The Fruit Grower's Guide

BY
B. F. HURST,
DISTRICT FRUIT INSPECTOR FOR DISTRICT NO. 5.

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FOREWORD.

The time has come when the successful orchardist is one of the most important factors in the up-building of our State. The fruit industry of Idaho (only a few years ago, entirely undeveloped and unsystematic) has reached a rank second to none. In the past decade it has more than doubled, and every year shows a tremendous increase in the number of trees set out and in the profits realized from the enlarged shipments. From three acres of Anjou Pears, last year, Mr. H. C. Myers of Boise received thirty-two hundred dollars. The Idaho Horticultural exhibit at Chicago in 1893 won fifty gold, silver, and bronze medals. At the irrigation congress at Ogden, where all irrigation states were invited to compete, Idaho won first prize, a five-hundred dollar loving-cup, for the best and cleanest fruit, freest from all insect pests. At the World's Fair in St. Louis, Idaho received gold medals on a collection of fruit, and fifty-six gold, silver, and bronze medals.

The climate is suited to the culivation and

improvement of the best species of fruit. The soil is unsurpassed. The state laws protect the fruit growers, as well as the buyers, from the incalculable evils of diseased fruits or trees. The throwing open of new lands, the development of irrigation projects (including the building of the great reservoirs,) the favorable market, all these influences are attracting capital into the planting of commercial orchards. Nature, the government, and the market have formed a powerful triumvirate to secure for Idaho a leading and honorable place among the fruit-producing states.

Now, while there is certain profit for every investor in orchards, it is absolutely necessary that the man who intends to go into the fruit business should inform himself fully concerning the best methods of carrying it on. What would be thought of any one's establishing a firm to handle farm implements if he did not know a plow from a mower? What chances for success would a person be likely to have who tried to mine without knowing how to tell valuable ore from non-mineral quartz? It is no more reasonable to buy or plant an orchard in ignorance of local conditions concerning climate, soil, best and most profitable varieties, and allied subjects. It is

to be regretted, however, that many such ventures are made. Unfortunately, their certain failures harm the community as well as the individual. When money is wasted in badly chosen stock, when the orchards are planted contrary to every sound principle of horticulture, when the trees are not properly pruned, sprayed, or watered, under these conditions the losses work serious injury to the orchardists and to his state.

It is with the intention of doing away with at least a part of these injudicious investments and practices that I have prepared this pamphlet. For a number of years I have devoted my entire time to the study of the orchardist's problems, and while I have not yet, by any means, solved them all, yet I believe that I am in a position to offer some useful suggestions and cautions deduced from my own and others' experience. It is the purpose of this pamphlet to discuss the problem of what kinds of trees to buy, their proper setting out, and how to care for them both in the healthy and in the diseased states. It seems to me that there should be a place for such a guide, and if it is of some use to any orchardist, it will have served its purpose.

Throughout the book acknowledgment has been made of the various sources used in

the preparation of certain parts, but I wish to make special mention here of my indebtedness to A. F. Hitt, State Inspector and Pure Food Commissioner of Idaho, for his helpful interest; to Alexander McPherson, former State Fruit Inspector and Pure Food Commissioner of Idaho, for his invaluable suggestions and critical reading of the manuscript; and to L. F. Henderson, Professor of Botany in the University of Idaho, for his generous permission to reproduce here parts of articles published heretofore by him.

B. F. HURST.

Boise, Idaho, Sept. 5, 1905.

The Life of the Tree.

Although it belongs more especially to the province of Botany to discuss the various parts of a tree and their functions, yet in a book which is meant to be a guide for the orchardist, it is certainly not out of place to give those points regarding which every man who is interested in trees should be informed.

In compilation of these facts, I have relied almost entirely on articles previously published; and by the kind permission of their authors, I am here able to reproduce those articles in an adapted form. The works chiefly consulted are as follows: "American Horticultural Manual" by J. L. Budd and N. E. Hansen; "Something of Plant Physiology, Theoretic and Applied" by Professor L. F. Henderson, published in the proceedings of the Eleventh Annual Convention of the Northwest Fruit Growers' Association.

A Tree.

ITS PARTS AND THEIR ACTIVITIES.

The parts of a tree are the root, the stem, the leaves and the flower.

ROOTS

The roots serve the purpose of holding the top erect and of supplying the water with its dissolved elements for sustaining growth.

The deep roots (tap roots) mainly take up the water, and the surface roots chiefly take up nitrates and the other essentials of growth.

The tap roots extend to a depth of twenty or thirty feet where soil is favorable, the depth depending on the nature of the sub-soil and the location of the water level.

The branch, or surface roots, reach farther than is ordinarily suspected; as a rule, they extend underground over an area as great as that occupied in the air by the spreading of the branches above.

If you examine the delicate end of a young root, inspecting it through even an ordinary magnifying glass, you will observe at its extremity a small brown cap fitting closely over the growing end and protecting it from abrasion as it pushes its way through the soil. A little back of this cap, tiny finger-like, single-celled root-hairs begin to appear, and farther back these root-hairs are seen to be of continually greater length until their full growth is reached, when they wither and drop off.

Through these little hairs covering a single

zone near the tip of each rootlet, which can hardly be observed by the naked eye, takes place practically the whole of the enormous absorption of water and salt from the earth.

The three most essential elements of the growth of a fruit tree are carbon, oxygen, and nitrogen. Carbon is provided through the leaves of the tree which are its breathing pores. Oxygen is furnished in the water. But nitrogen, although abundant in the air like the carbon, can not be assimilated by the plant except by means of the roots.

THE TRUNK OR STEM OF THE TREE.

The stem or trunk is the axis of the tree, the part which bears all the other organs. The particular characteristic of the stem is leaf-bearing. The place where the leaf or leaves are borne is called a node, and the naked place between two nodes is called an inter-node. The inter-node usually reaches its maximum length at the end of the first season. After this it increases in diameter but DOES NOT elongate. This point is often misunderstood.

The stem growth is divided into two classes according to the age which the stems obtain. Herbaceous stems live only one year. The

woody stems live more than one year, some even more than a hundred years.

As to cell growth, our cultivated plants are divided into two main classes; the "exogens" or outside growers, and the "endogens" or inside growers. Corn, asparagus, palm, fern, and all tropical fruits are inside growers. Trees are outside growers.

In the first division (Endogens) the new cell growth is mingled with the older tissue, and growth of the stem is accomplished by distension, or by pressing outward from the inside. This class of stem does not show the bark-wood and pith of the outside growers.

The exogenous division includes all fruit and forest trees.

HEART WOOD AND SAP WOOD.

In a one-year-old seedling, the stem is composed wholly of live or sap wood; but with increased age, the older layers, or rings of growth, are buried by the newer ones. The newer layers, with light color bark on the outside are called sap wood, or alburnum. As the tree gets older, the inner wood becomes drier, darker and more solid.

This interior dark wood is not alive. If kept from the air by the sap wood and perfect bark it may remain sound for a century or

more, but if the air is admitted by cutting or by accident, it will soon make a rotten spot in the stem.

The heart wood is not alive, as most people suppose, and, if it were, it could not carry any substance whatever to the tree. Only the roots can do this. Consequently, the boring of holes in the body of the tree, and the inserting of sulphur to destroy disease is entirely useless.

The heart of the tree may be perfectly sound, but is dead to all life-giving purpose. The life, or sap wood, is not more than one-half inch thick, and carries the sap from the roots. Anything taken into the tree must be placed at the end of the hair-roots and must be of the nature of the tree-food.

Mineral is not a food substance; consequently it will not be carried by the roots. Any break of the sap-passage would only be hurtful to the tree.

THE SAP AND ITS MOVEMENT.

The crude sap, which is gathered up by the root hairs at the end of the roots, is taken up by the larger roots to the trunk by way of the stem of the tree. It then ascends the tree rising through the sap-wood to all parts of the tree. The sap has a tendency to move

upward; and so all limbs that grow straight grow much longer than those that bend down because they receive more sap. This sap starts the growth of the bud, which develops the leaf and the new growth.

When the sap has reached the top of the tree it reverses its course, and on the way down carries food to all lower parts, especially to the young roots. As the sap descends, it flows along the inner bark, going mainly through the sieve-cells. These lie just outside of the Cambium layer, or that layer which yearly adds to the growth of wood on one side and bark on the other.

As the sap flows downward, all parts of the tree increase in size. If a label-wire is left on the stem of a young tree, we find that it is soon sunk into the bark and wood; and the part above enlarges, while the stem below remains the same size. This would surely show that cell-forming material descends near the Cambium layer. In the same way, if we remove a ring of bark in June from the stem of an apple tree, we soon check the downward movement under the bark. Presently we observe a process of healing over the wound by cell-formation in the cut surface above the ring. As the season advances, we notice the ripening and matured condition

of the wood above has changed leaf-buds into fruit-buds. This device is one often resorted to in order to force a tree into bearing.

LEAF-BUDS AND FRUIT-BUDS.

Buds that appear in the axil of the leaf are in some respects like seeds.

The grape, and some fruits and shrubs grow from planted buds in the ground, with a little wood attached, and it may be said that nearly all buds of woody plants will grow when inserted under the bark of the variety of the same species,

The greatest difference between the buds and the seeds is that the leaf-buds produce the individual parent without change, while the seeds re-produce usually the species, but not the variety.

The fruit-bud of the peach and of the apricots grows on each side of the bud. In the apple and the pear, the fruit-buds are formed on spurs.

Buds are usually formed in the nodes of the stem and in the axil of the leaves; but some species develop buds under certain conditions at any point along the stem or root. These are called adventitious buds. Some of these are cherries, and plums. Blackberries and

raspberries may develop such buds when cut back or wounded.

On the end of the spur by the stem of the fruit, if there is any fruit on the spur, a leaf-bud always starts. If the tree is not too heavily laden with fruit, this leaf-bud will change to a fruit-bud. If the tree has not vitality enough to mature the fruit on the tree and change this leaf-bud to a fruit-bud, this leaf-bud will remain a leaf-bud, and the spur will not bear any fruit the next year.

The fruit-buds are formed on apple trees through July and August. Any fruit-grower with experience can tell if the tree will bear fruit the following year.

The Leaf.

(Written by Prof. L. F. Henderson, University of Idaho.)

The leaf is a part of the plant beautifully adapted to certain ends. In most cases it is a horizontally expanded organ, with one side turned towards the sunlight, in order to enable it to catch as much of this as possible. To the naked eye it consists of a delicate frame work, holding out to light and air the green parenchyma or pulp that fills the intervals.

The purpose of the frame work is a double one, to hold out in a horizontal direction the

pulp, and to conduct rapidly water with its contents, called crude sap, to all parts of the pulp. If now we make a microscopical section of the leaf, and view it with a moderate power, we see a more wonderful mechanism for digestion and breathing than the human lungs and stomach, on account of its simplicity. We see first an impervious skin or epidermas covering both sides of the leaf, save where little mouths, or "stomata," leave ways open to the underlying tissues. These stomata are beautifully constructed so as to shut up when the leaf is lacking in moisture, and to open when there is an abundance. This controls transpiration, or loss of moisture, with exactness. At the same time they allow when open full egress to the air with its carbonic acid gas—a most important thing. Right under each stomata is a small air chamber, into which the air can pass readily. Then the cells of the green pulp, called the "mesophyll," are arranged very closely about these air chambers, and thus enable the air, when admitted through the stomata, to circulate freely amongst these cells of the pulp. If we look more carefully at one of these pulp cells, we find it irregular in shape, but with a uniformity as to work and contents. Each has a skin, each living protoplasm, each green color

bodies, or chloroplasts, and each a nucleus. These minute color bodies are wonderful things and fill a wonderful position in the "world's workers," for upon their action the plant depends for its own existence; upon its elaborated materials depend all parasitic plants, such as mildews, rust, scab and a host of others; upon it depend all saprophytic plants, such as mushrooms; finally upon it directly depend all animals, whether herbivorous or carnivorous, and man himself. It is no idle statement to say that were these little bodies to be suddenly and universally destroyed or cease for some reason their activities, all life upon the globe would cease as a consequence. These plastids, or green color bodies, are composed of protoplasm, and are colored green by the fluid called cholorphyll which permeates them. Their office is to accomplish, what no chemist has ever been able to do or ever will do, namely, under the influence of sunlight, change the inorganic materials in crude sap into organized carbohydrates, such as starch, sugar, cellulose, and many others. The crude elements needed, as before stated, are simply the carbon in the atmosphere, and the water in the soil when taken up by the root-hairs. But protoplasm cannot exist without a fourth element, namely,

nitrogen, nor could it do its work in building up the carbohydrates; nay, none of the proteids, such as exist in graham flour, beans, lean meat and a host of others, could be formed at all. The starch formed in this laboratory in the day, is carried away at all times while the leaves are on the trees, and nourishes not only the leaf, but flowers, stem and root. Truly we may say, therefore, that plant growth is more downward and outward, than upward and outward. The wood which always forms above a cut, not below it, on a tree is further evidence of this. Hurriedly and imperfectly I have attempted to explain to you this wonderful change of the raw materials all about us into the higher elaborated material needed for plant growth, and now to a few practical details.

It is now evident, why, when we cut off most of the roots of a plant, we should also cut down its top proportionally. Remember that no tree can absorb practically any crude sap except through its root-hairs, which are on the ends of the most delicate rootlets. As nearly all of these have been removed when the tree is taken from the soil, very little sap can ascend the trunk till more roots have been formed. If therefore all of the branches, and as a consequence all of the

leaves, are left on that weakened tree, they will tend to do too much work for the poor root system, and the plant will either die or be injured for many years. On the other hand how are you going to urge the plant to put out plenty of adventitious, or unusual roots, along the cut stubs left when the tree is planted? They can only be formed by having elaborated material sent down to them from above. Just as idle to expect them to form and do their work without this assistance as it would be to keep alive and at work a lot of coal miners underground without any provisions sent to them from without. The only true sources of supply for these forming roots are, first, from the reserve starch laid aside in stem, branch, and root fragments and turned into digestible sugar under the warming influences of the spring sun; second, new material elaborated by the leaves. Of course, before any leaves appear in spring, the roots must depend upon the first source of supply, but this will soon be exhausted and then there must be abundant leaves to furnish this material. So the proper balance is to make the head of the tree just large enough to do this work and no larger.

If the plant to be removed and replanted

be already in leaf, and especially if it be a large tree, as sometimes becomes necessary, the greatest care should be taken to leave a few strong leaders with their leaves, to cut back all the rest, and to cover their cut ends with tar, wax, or paint, so as to prevent the waste of sap and natural evaporation through the myriad open vessels which have been cut and have not yet healed over.

The Flower.

A knowledge of the parts of the flower is essential in detecting the varieties that ripen in the pistil before the pollen of the flower is ready for pollination.

Flowers are for the production of seed. Stems and branches which for a time put

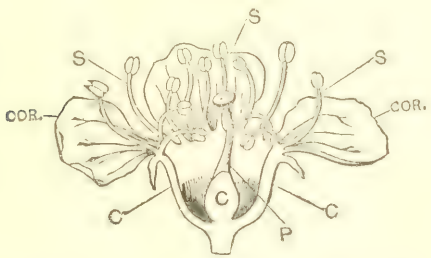

Figure 1. Divided Cherry flower. (After Goff.) "*c*," Calyx; "*cor*.," Corolla; "*p*," Pistil; "*s*," Stigma.

forth leaves for vegetation may at length put forth flowers for reproduction.

The circle of green leaves around a flower is called the calyx or flower-cup. Each separate part of the calyx is called a sepal. The colored circle of leaves within the calyx is called the corolla, and each separate leaf in this group is called a petal. Within these two circles stand the organs of the flower. One of these (there may be a large group of them in a single flower) is called the stamen. It consists of two parts; the long slender thread-like stem is called the filament. The knob at the top is the anther. Anthers are filled with pollen, a powdery substance made up of minute grains. The second organ in the flower is called the pistil. It also is composed of two parts. The slender thread is called the style, and the little knob at the top is called the stigma. At the base of the style is the ovary.

The pollen shed from the anthers, when they open, falls on or is conveyed to the stigma. These are afterwards fertilized by the ovary.

Flowers of the orchard fruits are divided in two classes, Inferior and Superior. In the Inferior flowers, the fruit is formed below the calyx as in the apples, the pears, and most seeded fruits. In the Superior flowers, the fruit is formed above the calyx. This is

the class to which belong the cherry, the plum, and the peach.

In the apple and the pear, the pistil and calyx grow together, and the fruit is practically the enlargement of the whole flower. In this class of fruit, the calyx is shown at the eye of the fruit; while in the cherry; it is shown at the lower end of the stem. The Superior fruits, such as strawberries, raspberries, peaches, plums, apricots, and grapes, are more exposed when in flower to the frost, and dry air, and other weather changes. And the ovary of the fruit-bud is more likely to be injured in winter, than that of the inferior, since the latter are protected by the base of the calyx. It is also true, as a rule, that the fruit that forms above the calyx is not as well fed as those below, as the connection with the leaves is not direct.

When the stamens and pistils are formed in the same flower it is called perfect or hermaphrodite, as in most of our orchards fruits, and garden plants. But when only one sex of these essential organs is found in the same flower, it is called imperfect. Even when the flower seems perfect in all respects, it often, in the cultivated fruits, seems incapable of self-pollination. This is not confined to the individual flower or to the flower of

a single tree, or to a large block of trees. As a rule, large blocks of a single variety of an orchard-fruit have not proved productive. We know that the most profitable orchards are those of many varieties, one variety sometimes refusing to fertilize itself.

The consensus of opinion at this time among experienced persons is that it is best to mingle varieties in a commercial orchard.

Varieties of our fruit differ materially in their blossoming habits. Some varieties expand all their flowers in a brief period, others seem to have two sets of flowers. If the first blossoms are destroyed by frost, the the later ones are numerous enough for a full crop.

The Making of an Orchard.

SELECTION OF LAND.

In the previous chapter, we have discussed the parts of a tree, their several functions, and the way in which the tree grows. Having reached now some understanding (however elementary) of a tree, the orchardist is better fitted to go about the making of his orchard.

In this undertaking, the first step, naturally, is the selection of land. Except in the arid belt, sloping ground is preferable, as the

drainage will be good. Trees should not have too much water, because it cuts off the supply of air from the roots, tending to suffocate them, and they, as well as the leaves, are breathing organs. (It may be remarked here, in passing, that pitted fruits do not require as much water as seeded fruits, and the planter should take these facts into consideration when setting out his trees.)

An orchard on a slope has the advantage of air-drainage and is not so apt to be affected by frosts. This is explained by the fact that cold air being heavier than warm air, it always seeks the lower levels, and, hence, tends to slide off the hill-sides and settle in the lower places where frosts are found not only to be heavier, but to occur later in the spring. Due to this circumstance, it may often be observed that the orchard on the side of the hill will escape frost entirely, while that in the hollows below is fatally affected. In regard to the soil, it may be said that a gravelly or porous soil, several feet underlaid, is excellent, for it doubly assures good drainage. A rich, loamy soil is of course the most desirable. In the irrigated section, ease and thoroughness of irrigation are of as much importance as drainage; but it should be remembered that water should

never be allowed to stand around the trees. Any land that grows tall, thrifty sage-brush may be counted on as highly desirable land for fruit-culture.

THE PREPARING OF THE LAND.

In the selection of land for an orchard, it is much wiser not to use virgin soil but to take, instead, soil that has been in clover and plowed under for a year or two, because the decomposed vegetation enriches the ground forming the much-needed humus. Perhaps a few useful suggestions may be made here as to the proper treatment of the land previous to its conversion into orchard and during the time the trees are bearing. This cultivation may be one of two kinds technically known as, (1) clean-culture, (2) cover-culture.

CLEAN-CULTURE.

By clean-culture is meant the plowing up and pulverizing of the land without using it for crops of any sort.

In all districts where the rain-fall is not sufficient for natural growth, or where there is a scarcity of irrigation water, it is absolutely necessary to cultivate the soil of an orchard. Otherwise, it will never be sufficiently damp. The force of capillary attrac-

tion in all firm soil is constantly sending the moisture upward to the surface. As fast as the top layer becomes dry, the moisture arises from below, and it also in turn is evaporated. During a long dry summer, this process will continue to a depth of several feet, the top layer of dirt becoming as hard and dry as a brick. Now, if the surface soil is broken up by cultivation, this difficulty will be avoided, because the force of capillary attraction will be destroyed as soon as the layers of soil are disturbed. The particles become so separated that the mutual connection of the small inter-spaces no longer exists.

To reach the most perfect results, the soil should not only be broken up in rough clods (though this treatment is better than none at all) but should be thoroughly pulverized. When this latter process has been well done, free access of air is not permitted to the lower strata at all. Fine loose earth acts as a blanket to retain the moisture, as only the surface which comes into immediate contact with the air dries out. The moisture which is preserved below is then kept for the exclusive use of the tree or plant. As fast as the supply is exhausted, it is replenished from the soil below; or, if evaporation ceases, the

roots will extend through the moist, loose soil and get all their needed nourishment.

This theory may be easily tested. Remove the top dirt from a considerable space in a well-cultivated garden or orchard, and you will find moisture two or three inches from the surface; while the same quality of land on an adjacent spot left uncultivated will prove to be dry to the depth of several feet. It will be nothing but hard earth, dry as a bone. In such a hard baked earth, the sun heat is also conducted downward very rapidly on a hot day, in many cases, of course, doing serious injury to the roots. A well-cultivated surface acts as a mulch, preventing rapid evaporation and the conveying downward of too great heat.

The depth of cultivation or the thickness of the mulch must be sufficient to prevent the access of dry air to the firm soil below. The drier the soil, the thicker the mulch or pulverization should be. Two or three inches over a hard pan-layer formed in some soils by cultivation, will not hold moisture well. Generally the cultivation should go twice that depth. Of course the capillarity in a heavy soil is much greater than in a light soil, and the pulverization of the surface is, therefore, much more difficult.

When pulverization is not thoroughly done, the soil should be broken up to a greater depth in proportion. A well-cultivated surface will both catch and hold the water more easily. Water flows off quickly from a hard surface to a lower level before it can penetrate the solid surface. Loose soil is porous like a sponge and holds all that falls upon it, the excess seeping away.

Let this be the grower's watch-word—"Cultivate in winter to receive the moisture. Cultivate in the summer to retain the moisture." Rain that falls in the winter seasons is often lost by too late cultivation. Do not fail to plow in the winter whenever it can be done without fear of washing away the soil. This is the best way to store the water below. It is a sad waste to allow the rain-water that is enriched by air-washing to carry away the soil particles. There results a three fold loss—the fertility of the rain-water, the loss of the silt, the most fertile part of the soil, and the loss of the moisture. It is best to plow early in the spring, when the vegetation has a good start, but when it is not yet so high but that it can be well turned under. The weeds at this time are not so woody and will rot more readily, thus acting as a fertilizer.

Clean-culture of the orchard and small fruit plantation, without the application of manure or other organic material, will soon so change the mechanical conditions of the soil that air cannot enter to give life to the protoplasm of newly formed and growing roots. The continual clean-culture without the aid of vegetable matter will soon take the humus from the soil, starving the roots and whole plant growth by lessening the supply of nitric acid and its combinations with alkalies, such as nitrate of soda and other useful plant nutriments.

COVER-CROP CULTIVATION.

In all irrigated districts, and in districts where the rain-fall is plentiful, the cover-crop is more beneficial than the clean-culture, and should by all means be preferred.

The best crops for this purpose are peas, beans, cowpeas, vetch, or other leguminous plants for soil covering during late summer and fall and for winter protection. This makes the conditions more like a natural forest, and supplies nitrogen and surface soil humus.

While the orchard trees are young, and the supply of plant food is plentiful, buckwheat makes a good shade for holding the moisture. It covers the ground earlier than the crops

first mentioned, and is easier to turn under.

When a crop of oats and wheat is desired, they may be used provided the soil is well broken up immediately after harvesting them. Neither one adds any virtue to the soil, but rather takes from it. They may be used merely for shade and for helping to bear the expense of the orchard until the trees begin to bear fruit. It is a good plan to sow clover with the grain (oats being preferred among the grains). Then plow the clover under late in the fall or in the early spring. This process should be pursued for at least six years. Afterwards, it should be sowed to red clover. Let the second crop of the second or third year go to seed, then plow it under in the fall. The decay of vegetation makes humus and enriches the ground, and the great mass of the many rootlets acts as a conductor to convey the moisture to a greater depth. When well-rotted, it makes the ground porous, thus aiding sub-irrigation. The ground should be leveled and ditches made at once, as the young clover may come up right away, and it should not be molested.

Some authorities contend that this kind of cultivation is a remedy for pear blight.

Many think that the continued orchard-culture uses up the moisture and robs the

fruit trees of it at the time when it is most needed for perfect maturation of the fruit.

The first and even second leguminous cover-crop sown in a bearing orchard will result in diminished supply of soil-moisture, as compared with the method of continual culture, yet this is favorable to the perfect maturing of comparatively young trees, and the turning-under of the two or more leguminous crops makes a fine supply of humus and nitrogen, which so changes the mechanical texture of the soil that it retains the moisture all through the season better than the cultivated orchards that have less of the nitrogen and humus.

(For a more exhaustive and thoroughly trustworthy treatment of the subject of clean-culture, consult "The California Fruits" by Edward J. Wickson, who has kindly consented to the adaption of his chapter on the topic which appears in this volume. For an exellent presentation of cover-culture, consult "American Horticultural Manual" by J. L. Budd, by whose kind permission his treatment of the matter has been used as a basis of discussion here.)

Buying the Trees.

If, now, the orchardist has properly prepared his land, his next problem will be a judicious selection of trees. In this connection it is important that he should know where and what he should buy.

Where to buy: Buy all trees of a home nursery-man, and select them yourself, so that you may be sure of getting good thrifty trees. Home nursery-men give a bond as to the proper name of the tree and as to its healthy condition. Trees that are shipped in are very often improperly labeled, as many orchardists have found out to their sorrow; and in many cases the plants are not in good condition.

What to buy: A yearling tree is preferable because it has not been ruined by improper pruning. For a commercial orchard, select not more than eight varieties of apples.

Below is given a list of varieties which I should consider preferable for an orchard in this section:

Eight Varieties of Apples:

(1) Yellow Newtown
(2) White Pearmain
(3) Winter Banana
(4) Grimes' Golden
(5) Roman Beauty
(6) Jonathan Wine Sap
(7) Arkansas Black

Four Varieties of the Late Pear:

(1) Anjou
(2) Winter Nelis
(3) Duchess de Bordeaux
(4) Clairgean

Two Varieties of the Early Pear:
(1) Bartlett
(2) Flemish Beauty
Two Varieties of the Prune:
(1) Italian
(2) Dawson
Five Varieties of the Peach:
(1) Early Crawford
(2) Elberta
(3) Champion
(4) Globe
(5) Wheatland
Two Varieties of the Nectarine:
(1) Early Newington
(2) Early Violet
Three Varieties of the Blackberry:
(1) Wilson
(2) Snyder
(3) Kittatinny
Two Varieties of the Dewberry:
(1) Lucretia
(2) Mayer
Red Raspberry:
(1) Cuthbert
(2) Logan—Cross between the red raspberry and the blackberry
Three Varieties of the Gooseberry:
(1) English Favard
(2) Chautauqua
(3) Industry

Two Varieties of the Strawberry:

(1) Green Mary

(2) Clide

In addition to this rather informal list, I offer a table of fruits which I have arranged in the order of their preference according to my judgment. For a still fuller list of tables consult government reports.

[KEY. SIZE, scale 1 to 10; 1, very small; 10, very large. FORM: c, conical; i, irregular; o, oblate; ob, oblong; ov, ovate; r, round. COLOR: d, dark; g, green; r, red; ru, russet; s, striped; w, white; y, yellow. FLAVOR: a, acid; m, mild; s, sweet. QUALITY, scale 1 to 10; 1, very poor; 10, best. SEASON: e, early; m, medium; l, late; v, very. USE: c, cider; d dessert; k, kitchen; m, market. Abbreviations of names of places of origin: Am., America; Eng., England; Eur., Europe; Fr., France; Ger., Germany; Holl., Holland; Ont., Ontario; Rus., Russia; Scot., Scotland.]

	SIZE	QUALITY	COLOR	FORM	FLAVOR	SEASON	USE	ORIGIN
Yellow Newtawn	7-8	9-10	ye	ro	a	vl	dkm	N Y
White Winter Pearmain	5 6	8 9	yr	robc	m	l	dm	Am
Winter Banana	8-9	8-9	wyi	rob	m	l	dkm	
Grime's Golden	5 6	9-10	y	roc	m	l	d	Va
Jonathan	6 7	8 9	yr	rc	m	ml	dkm	N Y
Rome Beauty	8 9	6-7	yrs	rc	m	l	dkm	Ohio
Winesap	5 6	7 8	yr	rob	a	vl	dkm	N J
Arkansas Black	7 8	7 8	yr	ro	m	l	km	Ark
Spitzenburg	6 8	10	r	obc	m	l	d	N Y
Gravenstein	8 9	8 9	yr	oi	ma	em	dkm	Ger
Yellow Bellflower	8 9	8 9	y	obc	a	l	dkm	N J
York Imperial	7 8	6 7	yrs	oio	m	l	dm	Pa
Swaar	7-8	7 8	gy	ro	m	l	d	N Y
Northern Spy	8-9	8 9	yrs	roc	m	ml	dkm	N Y
Rhode Island Greening	8 9	7-8	gy	ro	a	l	dkm	R I
Blue Pearmain	8 9	6	drs	rc	m	l	dm	Am
Gano	7-8	5 6	yrs	oi	m	ml	m	Tenn
Ben Davis	6 9	4 5	yrs	rov	m	l	m	Ky
Alexander	9 10	5	yrs	oc	a	m	km	Rus
Pewaukee	8 9	4 5	yrs	ro	m	ml	km	Wis
Early Harvest	5 6	9	yw	ro	ma	ve	dk	Am
Red Astrachan	7 8	5 6	rgy	rc	a	e	dk	Rus
Red June	3 4	6 7	rs	ovc	m	ve	dk	N C
Rambo	5 6	7 8	wyi	o	m	m	dk	Pa
Missouri Pippin	5 6	3 4	yrs	rc	m	l	m	Mo
Early Strawberry	3 4	6 7	yrs	rc	m	e	dm	N Y
Maiden Blush	5 6	5 6	yr	o	m	me	km	N J
Wagener	6 7	7 8	yrs	ro	m	l	m	Am
Walbridge	5 6	5 6	yrs	oc	m	l	dm	Ill
Willow Twig	6 7	5 6	yr	roc	m	ve	m	Va
Slayman	8 9	8 9	r	rc		l	mdk	Kan
Smith Cider	6 7	5 6	yrs	roc	m	l	km	Pa
Stark	8 9	5-6	yrs	robc	m	l	m	Ohio
Stearkey	7 8	8	yr	ocr	mo	ml	dkm	Me
Summer Pearmain	5 6	9 10	rrw	rc	m	em	d	Am
Summer Queen	6 7	5 6	yrs	rc	a	e	km	Am
Talman Sweet	5 6	6 7	y	ro	s	l	km	R I
Tompkins King	8 9	8 9	yrs	roc	m	l	dm	N J
Jefferies	5 6	8 9	yrs	oc	m	e	d	Pa
Limbertwig	6 7	3 6	gyr	roc	m	vl	m	N C
Mann	6 7	4 5	yg	ro	m	vl	mk	N Y
Minkler	6 7	6 8	gyr	rc	m	l	m	Pa
Northwestern Greening	8-9	6	gy	rc	m	l	km	Wis
Fallawater	9 10	6	ygi	rc	m	l	m	Pa
Fall Orange	8 9	3 4	yi	r	ma	m	k	Mass
Fall Jenetan	5 6	3-4	yr	cic	m	m	m	Conn
Famense	5 6	8 9	yrs	ro	m	m	dm	Fr
Fanny	7 8	5 6	rs	roc	m	e	m	Pa
Golden Russet	1 6	5-6	yru	ro	m	vl	dm	Eng
Baldwin	7 8	5 6	yr	roc	m	l	km	Mass
Rietigheimer	8 10	4	wgr	oc	m	em	m	Ger
Twenty Ounce	9 10	6-7	ys	r	m	ml	km	Conn
Wealthy	6-7	6 7	yrs	ro	m	m	dkm	Minn
Wolf River	9-10	5 6	wrs	ro	m	m	km	Wis
Yellow Transparent	6-7	5 6	wy	rc	a	e	km	Rus

PEARS.

	Size	Quality	Color	Form	Texture	Flavor	Season	Use	Origin
Anjou	7-8	8-9	gre	obtp	m	vp	m	dm	Fr
Duchess	9-10	5-9	gyr	obov	b	v	m	dm	Fr
Bartlett	7-8	6-8	yrur	ob	bt	jap	lm	dm	Eng
Rose	8-9	8-9	yrur	p	mb	p	m	m	Belg
Clairgean	7-8	4-5	yc	pl	bg	jsp	l	m	Fr
Clapp Favorite	7-8	5-6	yc	ob	bm	jsv	em	m	Mass
Dayenne du	8-9	8-9	yc	rp	mb	jsb	ml	dm	Fr
Danas Haver	3-4	9-10	yru	ob	m	jsp	l	d	Mass
Beurre	7-8	5-6	ygru	ro	bm	js	l	m	Fr
Flemish Beauty	8-9	6-7	yrur	ob	m	jsp	em	dm	Mass
Gifford	5-6	7-8	gyr	p	m	jvp	l	d	Fbm
Gray Dayenne	5-6	8-9	ru	ov	bm	rich	m	d	Fr
Idaho	8-9	8-9	yru	ob	m	sv	m	dm	Idaho
Keffer	7-9	3-5	yru	ob	m	jsp	e	d	Ohio
Lawrence	5-6	7-8	yru	ob	m	sp	l	dm	N Y
Josephine de	5-6	7-8	gyr	ro	m	jsp	l	dm	Belg
Seckle	3-4	9-10	lgrur	ob	bm	jp	ml	d	Pa
Sheldan	6-8	7-8	gy	ro	m	jsp	ml	dm	N Y
White Dayenne	5-6	8-10	yr	ob	bm	jsv	ml	dm	Fr
Wilder	4-5	7-8	yr	ob	t	sv	e	dm	N Y
Winter Nelis	5-6	8-9	yg	ro	bm	jsp	l	dm	Belg

NECTARINES AND PEACHES. (Persica vulgaris.)

Nectarines. (P. Vulgaris var. Lævis.)

[Key.—Size, scale 1 to 10: 1, very small; 10, very large. Form: c, compressed; o, oblate; ov, oval; r, round. Color: c, creamy; g, green; r, red; w, white; y, yellow. Adhesion: c, cling; f, free; s, semicling. Quality, scale 1 to 10: 1, very poor; 10, best. Season: e, early; m, medium; l, late; v, very. Use: d, dessert; k, kitchen; m, market. Abbreviations of names of places of origin: Am., America; Belg., Belgium; Eng., England; Eur., Europe; Fr., France.]

Peaches.	Size	Quality	Color		Adhesion	Form	Season	Use	Origin
			Skin	Flesh					
Early Crawford	8-9	8-9	yr	y	f	rov	m	dm	N J
Elberta	8-9	7-8	yr	y	f	rc	ml	m	Ga
Champion	7-8	7-8	cr	w	f	r	em	dm	Ill
Globe	8-9	7-8	yr	y	f	rov	m	m	Pa
Foster	9-10	9-10	yr	y	f	r	m	dm	Mass
Wheatland	9-10	6-7	yr	y	f	r	m	dm	N Y
Susquehanna	9-10	9-10	yr	y	f	r	m	dk	Pa
Heath Cling	8-9	9-10	wr	w	c	rov	vl	km	Md
Late Crawford	8-9	8-9	yr	y	f	r	l	dm	Am
Lemon Cling	8-9	8-9	yr	y	c	rov	m	dm	S C
Lemon Free	8-9	8-9	y	y	f	ob	l	dm	Ohio
Stump	8-9	6 7	wr	w	f	rov	ml	m	N Y
Sneed	6-7	4-5	gw	w	c	ov	ve	m	Tenn
Alexander	5-6	5-6	wr	cw	s	r	ve	dm	Ill
Crosby	6 7	7-8	yr	y	f	r	m	m	Mass

CHERRIES. (Cerasus.)

HEARTS AND BIGARREAUS. (C. Avium.)

[KEY.—SIZE, scale 1 to 10: 1, very small; 10, very large. FORM: c, compressed; h, heart shaped; o, oblate; r, round. COLOR: a, amber; b, black; p, purple; r, red; y, yellow. QUALITY, scale 1 to 10: 1, very poor; 10, best. SEASON: e, early; m, medium; l, late; v, very. USE: d, dessert; k, kitchen; m, market. Abbreviations of names of places of origin: Am., America; Eng., England; Eur., Europe; Fr., France; Ger., Germany; Ont., Ontario; Rus., Russia.]

	SIZE	QUALITY	COLOR	FORM	SEASON	USE	ORIGIN
Bing	7-8	8-9	b	....	l	dm	Ore
Black Heart	6-7	5-7	b	hc	ve	dm	Eur
Coe Transparent	5-6	10	yr	r	e	d	Conn
Centennial	9-10	8-9	yr	oh	....	dm	Cal
Downer	5-6	8-9	r	rh	m	dm	Mass
Eagle Black	6-7	6-7	b	oh	m	dm	Eng
Early Purple Guigne	3-4	6-7	pb	rh	ve	d	.....
Elkhorn	8-9	7-8	b	h	l	dm	.....
Elton	8-9	9	vr	h	e	dm	Eng
Hoskins	9-10	7-8	pr	rh	lm	dm	Ore
Knight Early	8-9	7-8	b	oh	e	d	Eng
[illegible]	[illegible]	[illegible]	pr	r	[illegible]	[illegible]	Ore
Lewelling	8-9	8-9	b	rh	....	dm	Ore
Mezel	9-10	7-8	rb	oh	m	d	Eur
Napoleon (Royal Ann)	8-9	5-6	yr	h	m	m	Eur
Oxheart	7-8	5-6	r	oh	m	dm	.....
Black Republican	8-9	....	b	....	vl	dm	Ore
Rockpeat	8-9	8-9	ra	oh	m	dm	Ohio
Yellow Spanish	9-10	9-10	yr	oh	em	dm	Eur
Black Tartarina	9-10	9-10	b	h	em	dm	Rus
Windsor	8	7-8	yr	h	l	dm	Ont
Governor Wood	7-8	7-8	yr	rh	em	dm	Ohio

"Heeling-in" a Tree.

After the selection of trees has been made at the nursery, and the trees have been taken home, the next step is to take proper care of them until they are planted. As soon as possible after the trees arrive at the farm they should be "heeled-in." This should be done even though it is intended to plant them almost immediately, for unexpected delays

often occur, and great damage may result if the process is omitted. By "heeling-in" is meant the protection of the fine roots so that they shall not come in contact with the air.

Plow or dig a deep trench or furrow (a double furrow would be best) in moist, light, well-drained soil. Put the trees in singly, side by side; be sure that all the packing material is carefully taken away from the roots. Lay the tops all the same way; then cover well with loose soil, making sure that the soil sifts down well between the roots to exclude the air. Generally, this treatment will keep the tree in good condition for sometime if need be. If the trees have become dry before arrival, the bundles should be thoroughly drenched with water before they are "heeled-in." If they seem to be very dry, the tops appearing to be shriveled, the trees, after being well drenched, should be buried root and branch in the earth two or three days. If the withering is not too far advanced, the bark will regain its plumpness and smoothness. It is seldom that trees are allowed to get into such a condition by neglect.

A good safe guard against confusion by the loss of labels is, when "heeling-in," to place each variety by itself in the trench. Usually, nursery-men fasten a label to each small

bundle naming the varieties, and the novice is apt to lose track of the different kinds when "heeling" them in the trench, unless he puts each by itself, and leaves the tag to mark the lot of that variety.

Setting Out the Trees.

WHEN TO SET THEM OUT.

For two reasons the fall is the best time for planting an orchard. In the first place, the ground is in better condition during that season; and in the second place, the orchardist is likely to have more leisure then and can plant without feeling hurried.

If the planting is left until spring, the late rains may keep the orchardist from planting until the season is so far advanced that the tree will not get a good start that year.

HOW TO SET OUT THE TREES.

When the orchardist is actually ready to set out his trees, he will find that the work can be greatly facilitated by following one of the plans given here.

Stretch a wire across the field where the first row of trees is to be planted. On the wire, at intervals of thirty feet, tie a narrow strip of cloth,—a piece of red cheese-cloth will

be found most useful as its color will insure its being easily discerned. Then make pegs a foot long and having a thickness equal to the circumference of the tree. Set a peg at each place designated by the cloth. Now remove the wire and stretch it again across the field parallel with the first row and at a distance of thirty feet. The whole field can thus be laid off before digging the holes preparatory to planting. Or, if it is preferred, the first row of trees can be planted without further delay.

Another and similar plan for laying off the ground is as follows:

On the wire that was used in laying off the first rows, tie a cloth of a different color half way between the red strips, which will make fifteen feet between the two. In this way the wire will be stretched parallel across the field every twenty-six feet, and your trees will be just thirty feet apart, the stakes in one row being tied with the red cloth, and those in the other, with the contrasting color.

DIGGING THE HOLES.

Take an inch board four inches wide and five feet long, and bore an inch hole at each end and also in the center. Then saw out a "v" on one side of the board to the center

hole. Now lay the board down so that the peg fits into the center hole. Drive a peg into the ground through the holes at each end of the board. Remove the board and the center peg. Dig a hole 2½ or 3 feet square where the peg was. When digging the hole, throw the top dirt over to one side of the hole, and the under dirt over to the other side. Dig to a depth of two feet, and then bore a hole five feet deep in the center. By using giant powder at this point, the hard pan that may be in the ground will be broken up, a surplus of water around the roots will be rendered impossible, and the tap roots will be able to descend to greater depths, in search of nourishment for the tree.

METHOD OF BLASTING WHERE THE TREE IS TO BE SET.

Use two sticks of giant powder for each hole. Drop one stick down in the hole. Loosen, at one end, the paper around the other stick of dynamite. At this end, insert a sharp peg the size of the cap to be used. Attach the fuse to the cap, and place the cap in the end of the powder. If there is water in the hole, cover the cap with wagon-grease, then draw the paper, and tie it around the fuse with a

string. Place this stick in the hole where the first stick was dropped, leaving the fuse about six feet long. The hole may be filled with water, or fine earth, but must not be tamped. Touch the match to the fuse. It is probably superfluous to say that the operator should immediately remove to a considerable distance from the hole.

This method of digging the holes will of course be an additional expense, but when it is realized that a tree thus set out will grow more in four years than another, carelessly planted, will grow in six, it will be seen that the time and money are well spent.

After the tree has been taken from the place where it was "heeled in," it should be set out at once while the earth, which has been thrown out of the hole, is damp.

All broken or bruised roots should be cut off with a sharp knife. Place the board with the pegs through the end holes. Set the tree in the hole. If the hole is found to be too deep, fill in with some of the top soil. The tree must now fit into the "v" in the center of the board. Place the tree in the hole, and throw in a few shovels of fine top soil. By grasping the tree firmly in the left hand and setting it, by moving it gently up and down a few times, and by working the

earth up under the center of the roots with the fingers of the right hand, all large air-spaces around the roots can be got rid of. The place directly under the crown, where the roots often form a sort of cone-shaped cavity, needs special attention. A large air-space here means severe drying. Be sure that this point is well covered with earth. The hole should then be filled, tamping well after each shovel of dirt has been thrown in. A tamper, shaped like a base ball bat, four or five feet long, and about three inches thick at the larger end, is excellent for this purpose. The rounded end will not easily injure the roots, and will be found small enough to work among them readily. When the hole is filled, a little loose dirt should be left on top as a mulch to retain the moisture. This should be piled 1½ inches higher than the surface of the ground.

It is not advisable to put manure in the hole, as it will heat and cause the roots to dry out, unless it is very well rotted. Moreover, it may introduce fungus spores, which will prey on the roots, and it is also likely to interfere seriously with the packing of the earth around the roots. A mulch on the surface made of manure or old straw is not so objectionable, though anything piled around

the trunk of the tree will make the bark more tender and more susceptible to injury after the mulch is removed. Such a mulch also tends to make the roots come close to the surface, and these soon dry out, if the mulch is not continually renewed or if it is removed entirely.

Pruning.

THE FIRST YEAR.

The newly set tree, which, as was said before, should always be a yearling, must now be pruned so that the top may correspond with the roots. This should be done at once. If neglected, the tree will suffer. Cut the tree off two and one-half feet tall making a sloping cut just above the bud.

THE SECOND YEAR.

When the tree is two years old, numerous small branches will have formed, and it will require more attention as to pruning.

Select five limbs which are to be left on the tree, the first being about one foot from the ground, and the others to be five or six inches apart on different sides of the tree. These limbs should be clipped one foot in length, leaving the fifth on the side of the tree from which the wind blows the most strongly,—it

will serve as a balance. All other branches should be clipped off just at the edge of the collar of the tree.

THE THIRD YEAR.

A third year tree will have small branches on each of these five limbs. Clip off all but two from each. The head of the tree is now practically formed. The pruning of the future has for its object the keeping of the tree free, so that the sun may reach the fruit. When pruning, cut the limb just inside the collar, because a limb, if cut too close, will leave a sunken place where insects may harbor. If cut too long, water sprouts will come. A tree that is heavily laden must be pruned in the summer. Clip off half the growth that the tree has made. This should be done in June or not later than July 15th. It checks the growth of the tree and causes it to send out fruit-buds for the next year. Limbs that bend downward will be found to be greater bearers than upright ones, because the sap in a bent limb will flow more sluggishly, and the growth instead of going entirely into a limb will be diverted to the fruit-buds. The straight limb will probably grow twice as much but will not send out anything like the number of fruit buds.

Some varieties of apples will send out fruit-buds on the first year's growth; of these the Winter Banana is an example.

As a rule, a limb will bear fruit the third year after its growth. The fruit-buds on an apple tree are formed in July and August, so that, in the fall, it may easily be determined whether the tree will blossom or not in the following spring.

Pear trees should be treated in much the same manner as the apples.

The treatment of the peach does not vary up to the end of the second year. As soon as the peach begins to bear, clip off half of the last year's growth or even more from the leaders. Form the tree into a goblet shape. Do this every year. The present year's growth of limb will bear next year but never afterward. By pruning, new shoots will appear and a heavier crop of peaches will be ensured. As peaches differ from apples in one important particular in that they do not need the sun, whereas apples do, it should be borne in mind that peaches should be protected by heavier foliage. In order to accomplish this, refrain from clipping the small branches that grow on the limbs. The best peaches will be found growing close on the

limbs that are well screened by this young foliage.

The prune and the plum require about the same treatment as the peach.

THINNING OF THE FRUIT.

The thinning of fruit is necessary for several reasons. It makes the fruit much larger and finer, and, what is of far more importance, it ensures the bearing of fruit on the tree for the following year; because any tree, if overloaded in one season, will bear scantily, if at all, the following season.

PEACH.

In the case of the peach tree, it is a singular fact that the limb which bears fruit one season will not bear again. Each year new twigs are formed. From this fact, it may be seen that all the nourishment of the tree in one season must not be given to fruit, but some of it must be allowed to develop new branches which will be fruit-producing the next year.

On a peach tree from five to seven years old, whose peaches will weigh two or three to a pound, only such a number should be left as would fill eight or ten ordinary commercial peach-boxes. (These contain from forty to fifty of the size mentioned.) Fifteen

such boxes represent the maximum bearing amount to be allowed on a tree from seven to ten years old. In order to make this estimate, count the number of peaches on one-fourth of the tree. After thinning them out, there should remain between eighty and one hundred peaches, or about two boxes.

In thinning, the larger number should be left near the main trunk of the tree, as the peaches grow larger at this point and are of better quality where they are protected by the leaves. In thinning peaches, it is well to follow the practice of leaving the fruit at intervals of from eight to ten inches. The distance will depend somewhat on the size of the limb.

APPLE.

The thinning of the apple should be done from the first to the fifteenth of July. At this time the large majority of the codling-moth worms are in the apple, and all wormy apples should be picked and put into a basket. These apples should be given at once to the hogs, or should be put into a barrel containing water. Into this barrel should be poured one pint of poison spray mixture and a quart of "Black Jack Oil." This will destroy all the worms in the apples. If the tree has no wormy apples, thinning should

be done by leaving one apple on each spur. If the tree is even then too heavily loaded, take off more. The necessity of this is made clear when one looks ahead to the next year's crop. If it bears too much, the tree will not have vitality enough to mature the fruit, or to change the leaf-bud to a fruit-bud. If a second thinning of the apple is made, it should be done about the tenth of August, as the second brood of codling-moth worms will be caught at this time. This date varies somewhat in different localities.

Gathering the Fruit.

GATHERING THE APPLE.

An apple intended for long keeping must be picked early. The Jonathan and most other varieties should be picked for shipping when the seed commences to blacken, and when the fruit yields to pressure. If left on until fully ripe and until the seeds are all black, the fruit will not keep. This applies to home storage as well as to shipment.

The apples should be carefully hand-picked into baskets. If to be stored, they should be placed carefully in apple boxes, not packed tight as for shipment. These boxes should be transferred to fruit-houses with as little jar

as possible. If apples are to be shipped a great distance, a layer of pasteboard should be placed between every two layers of apples, in packing. (Hood River packers use this method.) This would require the choosing of apples of uniform size.

Apples should be side-packed. That is to say, they should be packed with the sides, and not the ends, up. The box will be fuller when it reaches its destination, and the fruit will be in better condition. *Leave the stems on.*

GATHERING THE PEAR.

Stems must always be left on.

Each pear must be wrapped separately in paper.

Time for picking: The pear is ready to be gathered when the seed begins to turn black. Another successful way of determining its readiness for shipment is to let the pear, as it hangs on the tree, rest in the palm of the hand. If, when the hand moves gently back and forth, the pear detaches itself from the tree, it is ready to be picked. This test should, of course, be applied to a number of pears before a decision is reached. Pears should never be allowed to ripen on the tree. The flavor of a pear (as is not the case with most other fruits) is improved by early picking

and by being stored away in a cool dark place to complete its ripening.

HOW TO PACK PEARS.

The first row of pears (usually consisting of four, sometimes more if the fruit is small) is packed with the butts of the fruit toward the end of the box. The second layer (which always contains one less pear than the first) is placed with the stem-ends between the pears in the first row. All succeeding rows are packed in the same relative position as the second. The third row has as many pears as the first; the fourth as many as the second, and so on.

No interlayer of cardboard is used in packing pears as in packing apples.

In the second layer, the pears in the first row are placed with their butts in the hollows left by the stem-ends of the first row in the layer below. There will always be one less pear in the first row of the second layer than in the first row of the first layer. When the box is full the pears should stand higher than the sides of the box; for fruit should fit so tightly into a box that it will not shake about and bruise badly in shipping.

GATHERING THE PEACH.

Peaches intended for shipment should be picked before dead ripe. They should be

wrapped in two or three thicknesses of paper. The stem of the peach is removed. The box ordinarily contains two layers. It should have all small spaces filled with paper so that the fruit may fit very snugly.

GATHERING THE PRUNE.

The prune (Italian or Dawson) should never be picked until it has turned blue all over. The ripeness of the prune may be tested upon breaking it open. The sugary appearance of the meat and its sweet odor are the assurances that it is ready to be picked. Stems should always be left on.

In the prune basket (of which there are usually four to the crate) there are three layers, a piece of prune paper lying between every two layers. The largest prunes are saved for the top layer.

Prunes intended for evaporation should never be plucked. They must be left on the tree until they ripen fully and drop to the ground of their own accord. They will then have much more sugar. Evaporated prunes (both Italian and French) should be put into small paper boxes containing from one to ten pounds each. This method of packing would be of great advantage to the merchant who sells the prune, and the fruit itself

would be much better and cleaner. If prepared for sale in very small quantities, prunes could be disposed of in large amounts to travelers on the train, for many persons who now buy figs would gladly purchase prunes instead.

Irrigating the Orchard.

It would be difficult to state definitely at just what time to begin irrigating the orchard, because seasons vary so widely. In general it is best to wait until the trees are in blossom in the spring before irrigating at all. But if the spring rains have been infrequent and have ceased early, so that the ground has become dry, it is best to water the orchard even before the blossoms appear. When irrigation is once begun, the ground should be kept very moist (and I even advocate frequent flooding) until all danger of frost to the trees is passed. On any night which threatens a heavy frost, turn the water into all the irrigating ditches and see that the ground is flooded. This will be found an almost infallible protection against loss by freezing.

Frequency of irrigation depends very largely upon how the land lies and upon its peculiar characteristics. In general once every three

weeks should be sufficient. But if the land is very porous and has a decided slope, it will be found necessary to water it oftener.

The question is often asked whether or no an orchard should be flooded. It is maintained by some high authorities that flooding would cause the ground to bake. This might be the case where the orchard is cultivated by the clean-culture method. But in the case of cover-crop culture, it would not. In the later case, flooding, while not absolutely necessary to provide moisture for the growth of the tree, is yet invaluable as a protection of the crops against frost.

Irrigation should continue throughout the summer and into September. In case the tree is allowed to get too dry in the summer its growth will cease. Later in the fall when the rains come and while the weather is still warm, the tree will make a new start. This second growth is injurious to the tree, for freezing weather is likely to come on while it is in progress, and the death of the tree will result. This is more fully discussed elsewhere.

Smudge.

If the orchard is cultivated by clean-culture instead of by cover-crop culture, the best pre-

ventative of frost is not water but a smudge. In California the process of smudging is much more expensive and elaborate than that followed here. The plan usually adopted in this section is to distribute old hay and manure throughout the orchard and around all sides of it. The complete surrounding of the orchard is desirable because protection may thus be secured against a cold wind blowing from any direction. When the mercury begins to drop dangerously near the freezing point, the smudges should be lighted. The cloud of smoke permeating every corner of the orchard raises the temperature several degrees, and has in many cases saved fruit from total loss.

If the orchard is flooded, smudges will probably be superfluous. The presence of water (whether running or still) should be a sufficient protection.

Grafting and Budding.

It is desirable that every orchardist should understand propagation of trees. Often a poor selection of varieties are made, and it is advantageous to know how to make over an orchard of an undesirable variety into trees that bear finely flavored, healthy fruit.

There are two kinds of propagation, grafting and budding. In grafting, we have two methods technically known as whip-grafting and cleft-grafting.

Bulletins on this subject issued by the Department of Agriculture at Washington have been very freely used in presenting the following facts, especially Bulletin No. 113.

WHIP-GRAFTING.

This style of grafting is the one almost

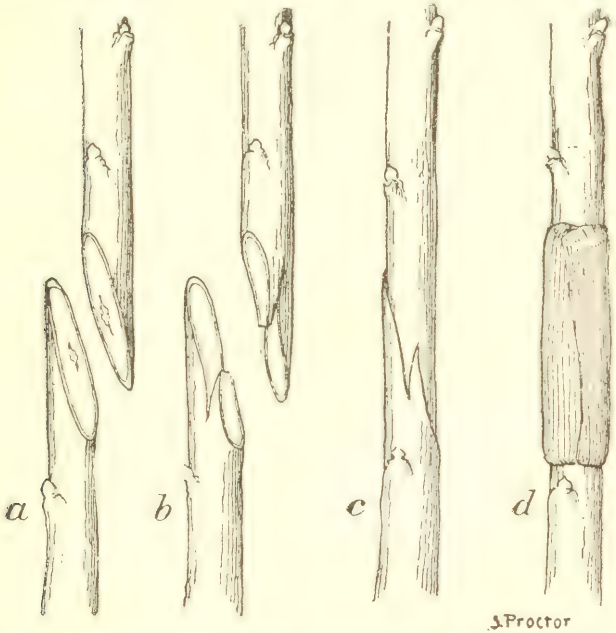

Fig. 2.—Successive steps of whip-grafting; *a*, splice-graft; *b*, tongue-graft, parts separate; *c*, tongue-graft, parts united; *d*, waxed wrapper applied.

universally used in root grafting. It has the advantage of being well adapted to small plants, only one or two years of age, as well as the fact that it can be done indoors during the comparative leisure of winter. The graft is made by cutting the stalk off diagonally, —one long smooth cut with a sharp knife, leaving about three-fourths of an inch cut surface, as shown in figure "*a*." Place the knife about one-third of the distance from the end of the cut surface at right angles to the cut, and split the stalk in the direction of its long axis.

Cut the lower end of the scion in like manner (Figure "*b*") and when the two parts are forced together, as shown in Figure "*c*" the cut surfaces will fit neatly together, and one will nearly cover the other, if the scion and the stalk are of the same size. A difference in diameter of the two parts to be united may be disregarded unless it be too great. After the scion and stalk have been locked together (Figure "*d*") they should be wrapped with five or six turns of waxed cotton to hold the parts firmly together. While the top-grafting may be done in this way, it is in root-grafting that the whip-graft finds its distinctive field. Sometimes the entire root is used. The roots are dug, and the

scions are cut in the fall and stored. The work of grafting may be done during the winter months. When the operation has been performed, the grafts are packed away in moss, sawdust, or sand, in a cool cellar, to remain until spring. It is important that the place of storage should be cool, or the grafts may start into life, and be ruined; or else heating and rotting may occur. If the temperature is kept low (not above 40 degrees) there will be no growth except callusing and the knitting of the stalk and the scion.

In ordinary propagation by means of whip-grafts, the scion is cut with about three buds, and the stalk is nearly as long as the scion. The graft is so planned as to bring the union of the stalk and scion not very far below the surface of the ground; but where the trees are required to be especially hardy in order to stand the hard winters, and the roots used are not known to be so hardy as the plants from which the scions are cut, a different plan is adopted. The scions are then cut much longer, and the roots may be cut shorter; and the graft is planted so deep as to cause roots to issue from the lower end of the scion.

When taken up to be set in an orchard, the original root may be removed entirely, leaving

nothing but the scion and the roots which have put forth from it.

CLEFT-GRAFTING.

This style of grafting is particularly well adapted to a large tree. Branches too large to be worked by other methods, can be cleft-grafted. A branch one inch or an inch and a half in diameter (a limb more than two and

Fig. 3.—Cleft-grafting; *a*, scion; *b*, scions inserted in cleft.

one-half inches should never be grafted) is severed with a saw. Care should be taken that the bark be not loosened from any por-

tion of the stubs. Split the exposed end with a broad thin chisel, or grafting tool. Then with a wedge or with the wedge-shaped prong at the end of the grafting tool, spread

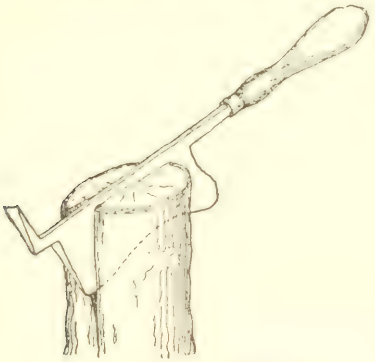

Fig. 4.—Grafting Tool.

the cleft so that the scions may be inserted.

The scion should consist of a portion of the previous season's growth, and it should be long enough to have two or three buds. The lower part of the scion, which is to be inserted into the cleft should be cut into the shape of a wedge having the outer edge thicker than the other. In general, it is a good plan to cut the scion so that the lowest bud will come just at the top of this wedge so that it will be near the top of the stalk. The advantage of cutting the wedge thicker on one side is illustrated in figure 3, which

shows how the pressure of the stalk is brought upon the outer growing parts of both scion and stalk; whereas, where the scion is thicker on the inner side, the condition would be reversed, and the death of the scion would follow. The importance of having an intimate connection between the growing tissues cannot be too strongly emphasized, for, upon this alone, depends the success of the grafting. To make this contact of the growing portions doubly certain, the scion is often set at a slight angle with the stalk into which it is inserted in order to cause the growing portions of the two to cross. After the scions have been set, the operation of cleft-grafting is completed by covering all cut surfaces with a layer of grafting wax.

The scions should be gathered in the fall. Clip off all the best and thriftiest shoots of the present season's growth (not water-sprouts). Each variety should be tied in a bundle by itself and labeled so that no confusion may result the next season. The clipped ends of the branches should then be buried from six to eight inches deep in a box of moist soil and placed in a cool cellar. Here they remain dormant until the next spring, which is the proper time for cleft-grafting.

THE COST OF CLEFT-GRAFTING.

Experienced grafters charge two cents a scion. When the charge is three cents, they guarantee the growth of all the scions, the latter to be counted the following fall. Thus the price of working over the top of a tree would range from twenty-five to fifty cents. The new top of a tree thus cleft-grafted will reach the size of the original top in three years and will be bearing fruit. This shows the advantage of cleft-grafting over the removal of an unsatisfactory tree and the replacing of it with a young one of a different variety.

BUDDING.

There are numerous styles of budding. It is the most economical form of reproduction, and each year witnesses its more general use.

Some nursery-men have even gone so far as to use it as a substitute for all modes of grafting except whip-grafting in propagation of the dwarf-pear. It requires less wood from which to take buds. A single bud does the work of three or more upon the scion used in grafting; but, while it is economical of wood, it is expensive in the use of stocks, —a seedling being required for each tree,— while with the piece-root system of grafting,

two, three, or more stalks can be made from a single seedling.

The operation of budding is simple and can be done with great speed by expert budders. The expense, therefore, is not more than that of whip-grafting, although it has the inconvenience of having to be done during the busiest season, that is to say, in the months of July, August, and early September. The usual plan for a man is to set the buds, and for a boy to follow closely and do the tying.

THE BUD.

The bud should be taken from the wood of the present season's growth. Since the work of budding is done during the season of active growth, the bud-sticks are prepared so that the petiole, or stem, of each leaf is left attached to serve as a handle to aid in pushing the bud home when inserting it beneath the bark of the stock. This is what is usually called a shield-bud, and it is so cut that a small portion of the woody tissue of the branch is removed with the bud.

THE STOCK.

The stock for budding should be at least as thick as the ordinary lead pencil. In the case of the apple and the pear, a second season's growth will be necessary to develop this size;

while, with the peach, a single season will suffice. Hence, peach-stocks can be budded the same season the pits are planted. For this reason, the peach is left until as late in the season as is practicable in order to obtain stocks of suitable size.

THE OPERATION.

Nursery Budding: The height at which buds are inserted varies with the tree. In general, the nearer the ground the better. The cut for the reception of the bud is made in the shape of the letter "T." Usually the cross-cut is not quite at right angles with the body of the tree, and the stem to the "T" starts at the cross-cut, and extends toward the roots for an inch or more. The flaps of bark caused by the intersection of the two cuts are slightly loosened with the ivory heel of the budding knife; and the bud, grasped by the leaf-stem as a handle, is placed under the flaps and firmly pushed into place. Its surface is entirely in contact with the peeled body of the stock. A ligature is then tightly drawn about, above, and below the bud to hold it in place until a union shall be formed. Bands of raffia about eight or ten inches long make a most convenient tying material. As soon as the buds have united with the stock

(which will occur in about twenty days) the ligature should be cut in order to prevent girdling of the stock. This done, the operation is complete until the following spring, when all the trees in which the buds have "taken" should have the top cut off about half an inch above the bud.

BUDDING IN THE ORCHARD.

In order to bud in the orchard, remove the top of the tree in the spring. The tree will then begin to send out from its top numerous small shoots. Bud as many of these shoots as will give the tree a good balance. This should be done in July, August, or September of the same season in which the tops have been removed.

The operation of budding in the orchard is performed in exactly the same manner as in the nursery. Immediately after the buds are set on a limb its top should be broken off entirely or should be twisted sharply and left hanging down until the next season. This would check the growth of the limb, and all the nourishment will thus go into the bud instead of into elongating the limb. The following spring the limb should be clipped with a sloping cut half an inch above the bud. If the limb does not heal over per-

fectly, it should be clipped again, this time closer to the bud.

BUDDING THE MARY ANN PLUM.

This is a plum that never sprouts from the roots. But if the top limbs of the tree are bent over and laid eight inches under the ground, each limb will take root. After they have taken root budding can be performed the same season. This will be a gain to the orchard of exactly one year over the method of planting the pit.

The Diseased Tree.

HOW TO TAKE CARE OF IT.

It is a regrettable fact that orchards in this part of the country, and, indeed, all over the United States, are in such a condition that any pamphlet treating of tree-culture will be found chiefly valuable in its discussion of diseases of the tree. Every orchardist is confronted year after year with the serious problem of ridding his trees of various pests if he does not want to see them die before his eyes, or at least cease to be profitable producers.

Observation and experiment have not as yet by any means reached the goal; but they are making excellent progress toward it.

The present writer aims to describe the diseases that have come under his notice and that have been studied by him; and to offer explicit directions concerning their diagnosis and treatment. The formulas and suggestions offered have all been successfully tested.

THE SPRAYING OF TREES AND SHRUBBERY.

Too much prominence cannot be given to the matter of spraying. The subject is one of which every orchardist must make himself master if he would be successful. It is the purpose of the present article to explain as carefully as possible, of just what benefit spraying may be, at which seasons of the year it should be done, how to make the spray, and how to apply it.

BENEFITS OF SPRAYING.

The spraying of trees has passed the experimental stage. Its value has been universally demonstrated. It is now recognized everywhere as a most efficacious means of treating insect-pests. It will protect a tree from a new invasion of disease, and will check and utterly rout the progress of any already infesting the tree. The spray covers up cracks and wounds made by insects and keeps out parasitic fungi trying to gain en-

trance to the cambium layer or inner-growing tissue. The rough bark, which is likely to harbor many enemies especially the codling moth drops off, leaving the new bark perfectly smooth. In this, the insects can not take refuge. They remain on the ground instead of making their homes in the trees, and eventually many of them are destroyed by irrigation.

In the case of trees already diseased, it has been conclusively shown that spraying is the only means of curing or even of saving the tree. If, for example, a tree attacked by the San Jose scale is left unsprayed, it will certainly die in two or three years. Aphis or slugs, by destroying the foliage or lungs of a tree, so check its growth that in a year or so it will cease to bear fruit. Spraying is the only sure remedy for this condition. The eggs laid by the codling-moth miller on foliage or fruit can be destroyed only by a poisonous spray, which both keeps the fruit from falling and also makes it larger and of better quality. Diseased rose-bushes or other flowering plants unless well sprayed will soon lose the beauty both of leaf and blossom. From these examples, it may be seen how incalculable are the benefits of the process. In short, there is no insect-pest found in this

region that cannot be coped with by an intelligent use of the proper spray.

WHEN TO SPRAY.

To secure the best results one should know just when to spray. If it is not done at the proper season it is of no avail. To be effective, the time of spraying should be carefully determined by the condition of the plant and by the sort of disease which has attacked it. If the spray is intended as a preventative of fungus disease, it should be applied early in the spring before the foliage starts. This, too, is the time to treat San Jose scale, aphis, and red spider eggs. If, however, the spraying is for insects that live on the fruit and foliage, it should be done at intervals throughout the summer.

For codling-moth it should be done several times; the first time, as soon as the petals fall and before the calyx closes, since some varieties blossom for a period of three weeks; the second time, three weeks later, so that the poison may reach into the calyx of the last blossoms. After this it should be done every three weeks for seven times. (As some varieties of apples, however, ripen before this period, it will not be necessary to carry out in their case the entire series.)

Spraying for slugs should be done two weeks after the eggs are laid on the leaf of the tree. Aphis should be treated as soon as detected. An earnest orchardist will, of course, familiarize himself with the appearance of all these pests so that he may recognize them at every stage of their development. After he has once detected the symptoms of the disease, and has diagnosed the case, he should be very careful to heed the suggestions concerning the proper season for spraying. Vigilance throughout an entire season is the price to be paid for healthy trees and shrubbery, and those who have neglected their orchards as the season advanced have done so at their cost.

HOW TO SPRAY.

But it is not enough to appreciate the value of spraying or to be conversant with the periods at which the treatment can be most effectively given. One must, above all things, know how to make the sprays; what ones to use in a given case; and how to apply them. These points, in fact, are the secret of the whole process. And it is just here, unfortunately, that orchardists make serious blunders. Either they do not know how to cook their sprays or they do not know how to apply it.

Whatever failures have occurred,—and they have been both numerous and costly,—they are all, I firmly believe, to be traced to mistaken methods of preparing the material and to injudicious methods of using it. Ignorance on these points have cost individuals in this state thousands of dollars. The San Jose scale, for instance, has been the source of a great outlay on the part of orchardists, and yet it is gradually increasing. This discouraging fact is due in great part to the improper mixing and cooking of ingredients. If the suggestions offered here are conscientiously followed, I believe that success will be assured. For all eating insects such as slugs, codling-moth, and peach-twig-borer, use poison,—arsenic of soda, or arsenic of lead being preferred. All sucking insects, as scale and aphis, should be killed by contact,—that is to say, by applying the spray directly to the insect. For this purpose, use lime, sulphur, and salt prepared as directed below, in the spring, but in the summer use whale oil soap and kerosene. For fungus diseases, use lime, sulphur, and salt in the spring and copper sulphate and lime in the summer. For detailed treatment consult Formulas I and II.

FORMULA I. To be used in the spring:

Salt, 20 lbs.; Sulphur, 35 lbs.; Lime, 70 lbs.; Water, 100 gals.

Put 60 lbs. of lime and 35 lbs. of sulphur in a barrel. Then pour in hot water just enough at a time to keep it from boiling over until the lime is slaked. Stir until thoroughly mixed. Cover the barrel. This mixture may stand from one to six hours and sometimes even twelve hours. It will usually be found most convenient to slake the lime and sulphur the evening before the spray is to be cooked. In the morning pour the mixture into a tank (capacity 100 gallons) which contains *not over three inches of water*. Boil thoroughly for one hour and a half. Take 10 lbs. of lime and 20 lbs. of salt and slake in a barrel while the other ingredients are cooking. After the first part has cooked one hour and a half, pour into it the slakened lime and salt, and cook another half-hour. Then add enough boiling water from a second tank to make when mixed 100 gallons. It is now ready for use and should be hot so that the full benefit of the sulphur may be had.

The great temptation in the making up of this and other formulas seems to be the use of too much water. If a greater quantity of water is used than I have indicated above, the entire effect of the sulphur and lime, is

lost. Again, many formulas (especially one from Ohio) do not give sufficient time to cook the materials properly so that the sulphur is used before thoroughly dissolved, in which condition it is simply clear waste. In the powdered form the sulphur is of no use whatever. I have tried as many as twenty formulas and find that in every case if too much water is used, some insects will not be affected at all; whereas if the receipt which I have given is exactly followed, all pests will be killed.

FORMULA II.—For any insect to be killed by contact.

Dissolve one pound of whale-oil soap in a gallon of water. Remove from the fire and add two gallons of kerosene, and churn until it forms a perfect emulsion. It will then be a creamy substance. This should then be diluted, the proportions of water varying with the kind of plant it is intended for. For apples, pears, and prunes, use 9 gallons of water to one of the mixture. For peaches or rose-bushes, use one gallon of the mixture to 15 of water.

FORMULA III.—For fungus diseases to be used in the summer:

Dissolve six lbs. of copper sulphate (blue stone) in hot water, using a wooden vessel

so as to prevent corrosion of metal. Add four lbs. of slaked lime with the copper sulphate, and mix well with 45 gallons of water. Then strain through a screen into the spraying barrel, and keep thoroughly stirred while spraying.

FORMULA IV.—Spray for eating-insects:

Mix 1 lb. of arsenic and 4 lbs. of sal soda in 1 gallon of water. Boil 20 minutes, or until dissolved. Use 1 pint of liquid to 50 gallons of water, and add 3 lbs. of slacked lime.

HOW TO APPLY THE SPRAY.

Be sure that it is properly applied to the tree or shrub. The correct way is to begin at the top. Spray through the tree from every direction until every limb and twig is completely covered. Otherwise an insect will still live. When the branches are well coated with the calcium sulphide, the air is excluded, and the scale dies. When spraying for aphis, codling-moth, or slugs, cover every leaf on the tree. Otherwise the insect has a chance to keep on working. All too frequently the foliage is not really covered, and the codling-moth continues its raids.

SPRAYING PUMP AND FIXTURES.

One should have a pump with a guage and

keep a pressure of from 100 to 150 pounds. The hose for each nozzle should be 50 feet long. The rod should be 10 feet long with a bamboo pole over it so that the hand will not be burned when spraying with the warm material. A lobe-valve should be attached to the rod near the hose. The best nozzle I know of is the San Jose nozzle. It will last one season and is easily regulated.

As to pumps, there are a great many kinds; some of them excellent, and many of them (and some of those are the most expensive) of little or no account. It is, of course, the part of economy and wisdom to get a good pump. I should recommend the Stahl pump. Or the Fairbanks-Morse pump.

FUMIGATION.

(The following interesting account of fumigation was contributed by Mr. J. M. Campbell.)

The formula used in fumigating is as follows:

1 qt. water, 15 liquid ozs. sulphuric acid, 15 ozs. bicarbonate of potassium, C. P. These ingredients should be put into an earthen vessel.

In the first place one should have an air-tight house or one as nearly so as possible. The trees should be dried off so that there will be no water or moisture on the surface,

for water will absorb the sulphuric acid and burn the tree.

Trees should be left in the house about forty minutes. If the weather is calm, I think the work can be done in less time than when the wind is blowing. It will not hurt the trees to leave them in the gas fifty minutes if they are in proper condition. Trees infested with San Jose scale, green aphis, and wooly aphis were fumigated and afterwards examined by Mr. Alex. McPherson, State Inspector, and he said he could not find life in either case. It is better to fumigate stock before it leaves out as the leaves will be wilted by the gas and sometimes killed. Our trees have always leaved out later.

It is dangerous for any person to enter the house for at least an hour after the door is open, as one can feel the effects of the gas to a greater or less extent even then. Every care should be taken as one breath of the gas would be fatal.

The room I use is studded up and down, papered with heavy paper, then sided with shiplap on the outside. On the inside it is boarded with shiplap; then heavy paper was put on with paste. The size of the room is 15 feet by 11 feet by 8 feet, containing in all 1320 cubic feet.

SCIONS TO SAVE GIRDLED TREES.

(American Horticultural Manual.)

Young orchard trees are often girdled in winter by mice, rabbits, and sometimes by sheep. If sawed off below the injury they usually fail to grow from the stub, as buds are slow in development at that point, and the sap-pressure, as the heat comes on, brings about ferment and low vitality of the stub and the roots. Such trees can be saved by cleft-grafting of the stub. A scion is inserted on both sides of the stub to favor the healing of the wound. If both grow, the weaker one is cut back after making growth enough to help in covering the wound on that side with cell-growth. The well established stub will give rapid growth from the strong buds of the scion, and in one season develop a tree with side branches. Trees saved in this way will come into bearing about as soon as those not girdled set at the same time. This plan is better to save young orchard trees than inserting scions to bridge over the stem injury. But where quite large trees are disbarked in any way in the dormant season, it is best to spring in scions as shown by figure 5. When the bark begins to peel in spring, scions somewhat longer than the space to be bridged are cut

to a wedge at each end as for cleft-grafting, and by bending the scion, the wedge ends

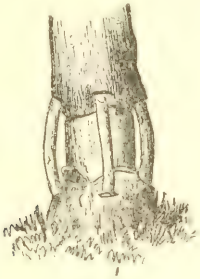

Figure 5.

are slipped between the bark and wood through openings cut above and below the injury. The parts are waxed, and then the whole is covered with burlap or old cloth.

THE SAN JOSE SCALE.

One of the most interesting as well as notorious of insects is the San Jose Scale, which had its starting place in America in the California town for which it is named, and which has become famous among orchardists the world over on that very account. The tiny scale has, in fact, been the means of making insects internationally important and of giving them a prominent place in the regulation of commerce. Its discovery and investigation have aroused both at home and abroad general and keen interest in the whole subject of insect

control. And this pest has been the indirect means of the finding out of effective and valuable methods for checking others.

HISTORY AND ORIGIN.

(This section was adopted from Year Book of 1899, U. S. Department of Agriculture).

The story of the origin and career of this insect is not without interest and has been the subject of much dispute and study. It was first noticed in this country in the grounds of Jame Lick in San Jose in the early seventies, and from there it was known to have spread to other orchards which had direct communication with those of Mr. Lick. He was a great lover of imported trees and plants, and it was naturally inferred that in some of these importations he had introduced the insect. However, as Mr. Lick's death occurred before the investigation was well started, it was impossible to trace his importations.

The United States government then sent entomologists to eastern countries mainly to Japan and China; and some investigators went to Europe. The scale was found in many places, and, in nearly all cases, it was observed that the original nursery-stock had been brought from the United States. In China, the Commission found Haw apples, the native pear, and the crab-apple infested.

This was a significant discovery. The Haw apple is a wild fruit growing on the hill-sides of that section of China, and the native crab and pear have grown there immemorially. Therefore the occurence of the San Jose scales on these fruits had but one explanation,—that in this region it was a native. No United States importations had reached that place. The conclusion seemed to be established that Mr. Lick had brought it to America in some nursery-stock imported from North China. It is the general belief that it came here on the flowering Chinese peach.

Up to 1893 the San Jose scale (which is then properly the Chinese scale) was not known to have reached the important pear and apple districts of the eastern and middle states. At this time, however, it was seen in a small orchard in Charlottesville, Va. Upon investigation it was found that the insect had appeared in some large eastern nurseries six years earlier on plum trees obtained from the San Jose district, and that it had thus spread to other nurseries, which had sent their stock over the eastern and southern states.

The great importance of this discovery was generally recognized, and every effort was made to find the places of infestation,

with the idea of exterminating the pest before it had become too widely scattered. This, however, was proved by the work of a year or two to be an idle hope. It was demonstrated that the scale could not be exterminated, but can be controlled by spraying and fumigating. The result of fears awakened in the United States was transferred to foreign countries, and, beginning with Germany, one after another adopted measures prohibiting the importation of American plants and fruits or requiring rigid examination before admission. Canada also adopted similar restrictions, and, as a result our foreign trade in plants and fruits was much curtailed. In spite of all efforts the San Jose scale has slowly extended its range until it now occurs in every state in the Union and in portions of Canada. It is most abundant in the Pacific Coast States and in the Atlantic and Gulf States. There is less in the middle west and central states of the northern part due, perhaps to the rains and extreme cold.

The early losses from it were considerable, as it is perhaps the only scale pest which, unchecked, will in two or three years actually kill the plant attacked.

APPEARANCE.

It is a small lemon-colored louse covered

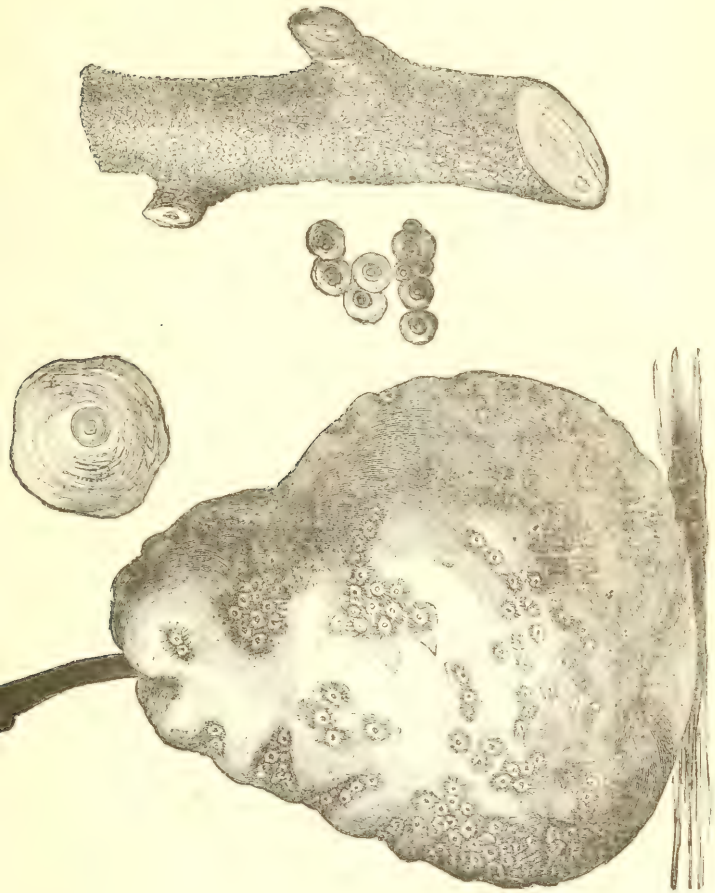

Figure 6.—San Jose Scale.

with a dark brown scale about the size of a small pin head. The male scale is elongated, while the female is circular. When highly magnified it resembles the pupil of the eye, and when dead it is of a grayish white.

HABITS.

The female scale when once settled on a limb, never moves but sucks the sap out of the tree until the tree dies. If the tree is cut down and the flow of sap is stopped, the scale dies in a few days.

The mother scale commences bearing young about the first of June. She bears from one to five each day for a period of six weeks and then dies. The young scale comes to maturity in about twenty-three days, and is then ready to reproduce. Thus the progeny of a single scale in one season will reach into tens of millions. The young scale is about the size of a point of a pin, and moves over the limb with the rapidity of a small ant.

A bird, especially the crow or the robin, carries scales from one place to another; they light upon an affected tree, and the young scale gets onto their feet and is carried for miles in this way. Flies and bees carry it as well. On an apple tree it makes red spots

on the bark and this is more easily detected when the bark is wet. When the tree is badly affected, it looks as though it were covered with wood-ashes. A badly affected prune, cherry, or plum tree holds its dead leaves all winter, but a plum or prune that is only slightly affected can be detected by rubbing the finger over the limb. A greasy streak will appear wherever there is a scale.

It attacks all kinds of fruit trees and shrubbery; it is worse on currants than on any other berry and is bad on the hedge fence, sometimes known as osage orange. It affects forest trees but slightly—mountain ash more than any other.

When the young scale is crawling on the tree it gets into the leaves and the fruit. Those that get into the leaves perish when the leaves die. On an apple, it makes little red spots in the center of which is a small black spot, which is the scale. When one rubs off the scale, there is left a tiny white spot which shows where it has once been.

HOW TO TREAT THE SAN JOSE SCALE.

There are just two ways to treat the San Jose scale. One is to cut the tree down and burn it up. The other is to spray with the lime, sulphur, and salt spray, according to

Formula I, page 69. Other formulas have been frequently advanced, but they have never proved a success. If the ingredients as given in Formula I, are cooked carefully according to directions as to length of cooking and amount of water, there cannot be the least question that every scale on a tree will be killed if every portion of the tree is reached by the spray. The spraying should be done while the tree is dormant.

OYSTER SHELL BARK SCALE.

(Fourth Biennial Bulletin of Idaho State Board of Horticultural Inspection.)

This pest is not nearly so dangerous as the San Jose scale, but is much harder to destroy on account of its breeding habits. The mother deposits from thirty to sixty eggs in the fall underneath the shell. These eggs are very small but hard like a hen's eggs. The mother shrivels up after depositing all the eggs, and the shell remains over them until the hatching period in June. Some say that it is impossible to spray during the dormant season but I do not agree with them. Although the eggs are well protected with the outside shell, yet they can be destroyed by adding 6 boxes of lye to every 100 gallons of the lime, sulphur and salt spray as in Formula I. The lye eats into the outer

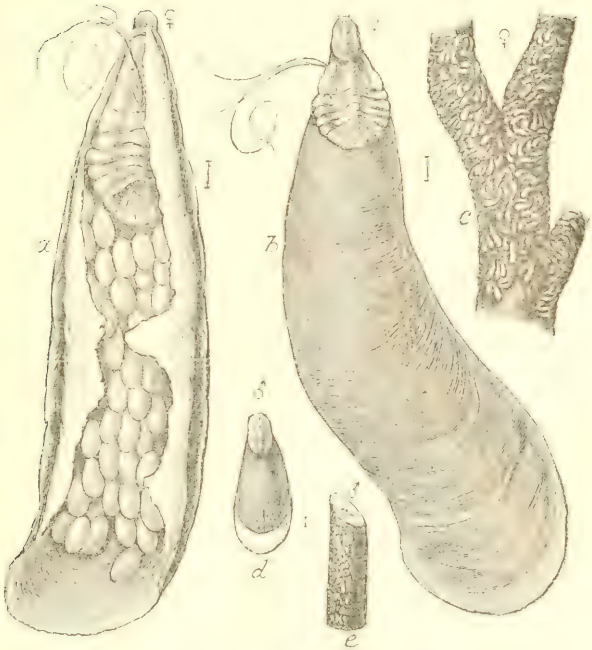

Figure 7.—Oyster Shell Bark Scale.

shell and leaves them exposed. Consequently very few hatch.

PUTNAM SCALE.

(Idaho Bulletin of 1902.)

This insect reproduces its species through the medium of the egg. It is therefore not nearly so dangerous as the San Jose or Curtis scale.

It is a native of this country and conse-

quently is wide-spread, extending from New York to California. The exuvia or center of the nipple shows when rubbed slightly orange instead of lemon color. The discoloration produced on light barked trees by this scale does not penetrate so deeply as that of the San Jose scale for while the purplish color of the San Jose scale extends into the bark, the discoloration of the Putnam scale seldom goes deeper than the epidermis or surface. For this reason it is often mistaken for the San Jose scale. I have never found it in such numbers as to do great harm. It is to be found mostly on cottonwoods. Spray with lime, sulphur and salt spray in spring.

THE CURTIS SCALE.

(Idaho Bulletin of 1902.)

This species of scale stands next to San Jose scale in importance on account of its being viviparous, that is, it produces living young, and is oviparous or egg-laying. The exuvia or center of the nipple is surrounded by a whitish ring. This scale does not have a real margin around it as has the San Jose, and it is of a rougher appearance.

This scale should be sprayed with the lime, sulphur and salt spray in the dormant season. Formula I.

COTTON CUSHION SCALE.

(Economic Entomology by Jno. B. Smith, Sc. D.)

Cotton Cushion scale is mostly found on the maple tree. It usually attracts attention in spring when cotton masses become numerous on twigs or leaves, increasing in size until they are one-fourth of an inch in length.

Figure 8.—Cotton Cushion Scale.

The mass seems cottony, but it is actually a wax or gum. If a bit is taken up with the fingers, it can be drawn out into a string six inches long. It forms a bedding for minute

eggs which have been laid by insects under the brown scale which forms the head of the mass attached to the twig. From these eggs, minute crawling larvae hatch much like the eggs in color. In a day or two each larvae inserts its beak into a leaf or twig, and a little flattened oval scale is formed. This scale is not very destructive as birds pick them off. They can be killed by spraying in summer, when the young hatch, with Formula II.

ROSE AND BERRY SCALE.

(Fourth Biennial Bulletin of Idaho State Board of Horticultural Inspection.)

This scale usually attacks shrubbery such as raspberries, blackberries, gooseberries, currant-bushes, and rose-bushes.

It is pure white and very conspicuous, a little larger than a pin-head when full grown. Spray with lime, sulphur and salt spray (Formula I) in the dormant season.

CODLING-MOTH OR APPLE WORM.

(In writing up the codling-moth, the flat-headed borer, the peach-tree borer, the peach-twig borer, the red-spider, the pear and cherry slug, the apple scab, and mildews, the present writer has reproduced the articles on those subjects as published in the Fourth Biennial Bulletin of the Idaho State Board of Horticultural Inspection, and prepared by Mr. Alex. McPherson. Certain modifications have been made in accordance with later experiments made by the present author.)

The codling-moth is the most serious pest with which the fruit-grower has to contend and has been known for over 2000 years.

Its original home was probably southeastern Europe, and it has spread until it probably infests every apple-growing section on the globe. The moth was first noticed in Idaho twenty-four years ago and was thought to have been brought here in a shipment of eastern apples. At the present time nearly every orchard is more or less infested.

The larva passes the winter in a silken cocoon hidden in crevices and under the rough bark of the tree. It will seek a home almost any place where it can hide away. Packing and storage houses often become veritable pest-houses unless they can be thoroughly disinfected.

In the spring the larva changes to a pupa and a few days later the moth emerges. As soon as the moths come forth they pair and in a few days begin to deposit their eggs; sometimes on the apple, but more often on the twigs and leaves. The eggs are white, circular, and nearly flat. The moth usually remains at rest during the day and deposits its eggs late in the afternoon or in the early evening. Hatching usually begins in six or or seven days and continues for an indefinite

period. The larva or worm when hatched is but little larger than a horse-hair, the body being white or pink and the head black. It feeds two or three days on the leaves or on the outside of the apple; then seeks the apples, entering at the calyx or eye as the

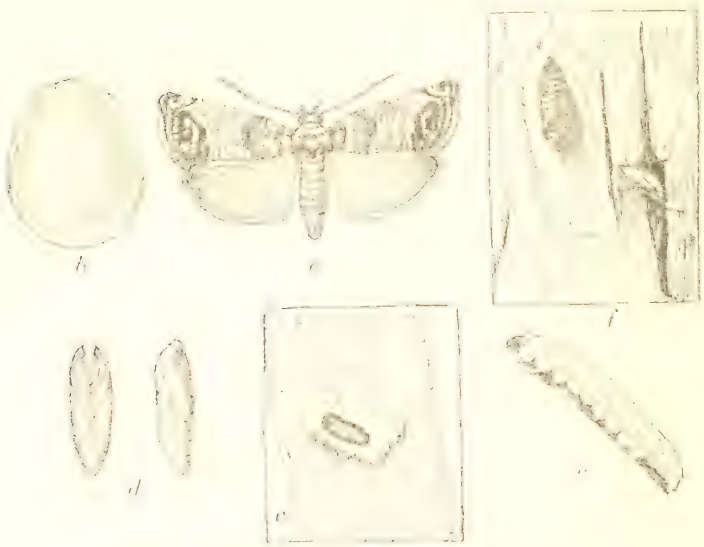

Figure 9.—The Codling Moth or Apple Worm.

a, the moth or adult insect, slightly enlarged; *b*, the egg greatly enlarged; *c*, the full-grown larva slightly enlarged; *d*, the pupa, slightly enlarged; *e*, the pupa in its cocoon on the inner surface of a piece of bark, reduced about one-half; *f*, moth on bark and empty pupa skin from which it emerged, about natural size (original).

Codling Moth.—From Farmers' Bulletin No. 171, by permission, U. S. Department of Agriculture, Division of Entomology, by C. B. Simpson.

skin of the apple seems more tender at that point.

The worm feeds a few days just under the skin and then proceeds to tunnel towards the center of the fruit. When full-grown, (this requires about twenty-one days) it tunnels to the outside of the fruit again. If the wormy apple falls to the ground, the worm will leave the apple and crawl to the base of the tree or to the nearest hiding place. If the apple remains on the tree, the worm will come down either by its spinerette or will crawl to some hiding place on the tree; and in seven or eight days it is transformed to a miller again.

The moth is of a dark brownish gray color, and when at rest its wings are closely folded. The ends of the wings are V shaped with a copper-colored border, although sometimes a dark cream-colored moth is found. Otherwise their form and shape are nearly always the same, being about three-fourths of an inch long.

The question of the number of broods is as yet unsettled. Some claim that there are only two broods, but I am inclined to think from the fact that the first miller appears early in the spring and that millers can be found as late as October, there must be three broods.

I have never detected a codling-moth miller on the tree. They always remain hidden during the day. They are very wild and fly rapidly. They are never attracted by light, but, on the contrary, avoid it. Most millers seen are not codling-moth millers as is erroneously supposed. They may be seen only by letting the worm hatch in a glass jar.

TREATMENT OF CODLING-MOTH.

In fighting the codling-moth the first thing to do is to destroy all the larva before they have time to become moths. The store rooms or other places where apples have been kept should be gone over and all the larva destroyed; rubbish and trash should be removed from the orchard and burned; all boxes and other places where the worm might hide should be thoroughly examined and the worms killed; then in February or March shovel away the earth around the tree to a depth of three or four inches; this is necessary as many of the worms find refuge in the bark and cracks just under the surface of the ground. Then take a heavy piece of muslin or canvas and hem one side over a strong cord; tie this tightly around the tree close to the ground; scrape off all rough bark, clean out all cracks where the worm

might be in hiding, clean out all holes, pare smooth all cuts and broken places.

BANDING.

Banding the trees is one of the essential adjuncts for the control of the moth, as well as being an aid in determining the proper time to spray. About four weeks after the blossoms fall put on the bands. The band should be of somewhat fuzzy texture, double and as wide as convenient; about four inches will do. It should be just long enough to pass around the tree and lap over two or three inches. Drive a box nail into the tree, leaving it stick out about one inch; cut the head off the nail with a pair of clippers; fasten one end of the band on the nail; pass it around quite closely and fasten the other end. The bands should be watched and as soon as the worm appears they should all be taken off and the worm killed. After the worms begin to appear the bands should be examined and the worms killed every eight or ten days until the fruit is picked. After this allow the bands to remain until all the straggling worms have gone under the bands, which is usually sometime in December. If the trees are large, having limbs near the ground, it is well to band each limb as well as the trunk.

SPRAYING.

Use Formula No. IV. Follow carefully directions given as to when to spray in the chapter on the Spraying of Trees and Shrubbery, page 71.

THE FLAT-HEADED BORER.

(Apple Tree Borer.)

This insect usually attacks the apple but is often found attacking other trees.

It is a pale yellow-colored grub with a flat head very large in size as compared with its body.

The larva makes irregular channels or chambers under the bark girdling and killing

Figure 10.—The Flat-head Apple-borer; *a*, larva; *b*, pupa; *d*, adult.

the young trees. The mother beetle lays the eggs in June or July. The larva lives from one to three years before coming to

maturity. It seldom attacks healthy strong growing trees.

It may be detected by means of its costings which are thrown out as the insect works its way into the tree.

In seeking a remedy for this borer, it will be found best to wrap the young trees with several thicknesses of strong paper extending two inches below the surface of the ground to the first limb and tied rather tightly at the top to prevent the mother beetle from getting inside the paper. I have tried this remedy many times and have succeeded in saving the trees so wrapped from the ravages of the borer. Other checks which I left as checks were killed. In case the tree has not been well wrapped and the borer has entered, it should be searched for and when found taken out and killed. The tree may recover.

PEACH TREE BORER.

The female of this moth deposits her eggs in the bark of a tree close to the ground. The eggs are very small, oval in form slightly flattened at the ends, and of a dull yellowish color. They are fastened to the bark by a gummy secretion. As soon as the worm is hatched, it works downward to the bark in the root forming a small winding channel that soon fills with gum. As the worm in-

creases in size, it devours the bark and sap causing a copious exudation of gum around the base of the tree. It sometimes attacks the tree farther up, usually in the fork; but it may be detected at any time by the presence of the exuding gum. Its operations are not always confined to the peach, as it also works on the plum. The moth which produces the borer looks almost like a wasp. It should be treated the same as the flat-headed borer.

PEACH TWIG BORER.

(Anarsia Lineatella.)

This grub is the larva of a moth, about half an inch in length when fully grown, and

Fig. 11—Anarsia lineatella: *a*, twig of peach, showing in crotch minute masses of chewed bark above larval chambers; *b*, latter much enlorged; *c*, a larval cell, with contoined larva; *d*, dorsal view of young larva more enlarged (original).

Peach Twig Borer—From Farmer's Bulletin No. 80, U. S. Department of Agriculture, Division of Entomology.

of a light reddish color. It only attacks trees bearing pit fruit. It passes the winter in its cocoon in the cracks and crevises of the trees, transforming to a moth about the time the trees begin to bud, which soon begins to lay eggs as the young twigs start. From the effect of their work the ends of the young shoots begin to wither. At the first appearance of the young shoots having a worm in them, they should be cut off and burned. The second brood attacks both twigs and fruit. The first brood appears in May, and the second in July and August. This insect is intermittent, the number of insects apparently being greatly reduced some years by natural causes.

TREATMENT.

Use Formula No. I in the dormant season.

RED SPIDER.

This is very small. It is found mostly on peach and pear trees. It works around the forks of the limb and sucks the sap from the tree. It lays its eggs in the fall on the tree, and they hatch early in the spring just as the buds open. The eggs are so small that they can not be seen with the naked eye. With the aid of a magnifying glass, millions may be observed on a small limb.

They should be sprayed early in the spring

with the lime, sulphur and salt spray, as in Formula No. I.

PEAR AND CHERRY SLUG.

This is a dark shiny larva that feeds on the leaves of the pear and cherry. It some-

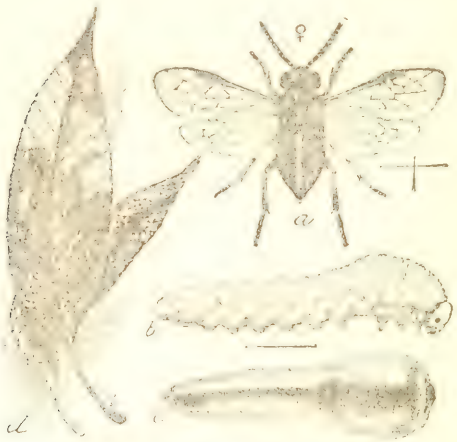

Figure 12.—Pear and Apple Slug.
a, adult; *b*, larva; *c*, same in normal state; *d*, leaves with the larva attached natural size; *a*, *b*, *c*, much enlarged.

times attacks other trees as well. It does considerable damage by eating away the pulp of the leaves which then wither making the tree unable to mature its fruit.

There are two broods in a season; the first brood hatches about the first of June and the second in July.

The slug-fly lays the eggs in the leaves during the last of May and they hatch in about two weeks. If left alone, they will render a tree unproductive and perhaps kill it entirely.

They should be sprayed as soon as detected on the leaf as they eat rapidly. Spray with poison, as in Formula IV.

APPLE SCAB.

DESCRIPTION.

The apple scab attacks the leaves and fruit. The first indication of the disease is shown by light spots on the leaves, afterwards turning to a dirty green or black color; as the season advances it is shown on the fruit by dark green or blackish spots surrounded by a narrow white margin that loosens, but does not destroy, the cuticle of the apple. The disease in its worst state causes the dropping of the foliage from the tree. The apple ceases to grow and becomes distorted and unsightly. The fungus receives its sustenance within the outer skin of the apple. Thus the damage is restricted to badly spotted or distorted fruit, rendering it worthless and unsaleable. The spores are distributed by the wind and rain, the disease making its greatest headway during moist warm weather. If the disease

is allowed to run unchecked the tree becomes dwarfed and unprofitable.

The apple scab is one of the most pernicious fungus diseases we have to contend with and in the humid portions of the State it is quite a serious pest. Yet it can be successfully subdued or eradicated if fruit growers will follow the directions given. As a multitude of spores of the apple scab pass the winter on fallen leaves, they should be plowed or spaded under in the dormant season, or, better still, raked up and burned. All twigs, trimmings, etc., from the orchard should be gathered up and burned, and the orchard sprayed with Formula No. I, just as the buds are beginning to open. It is not only the best fungicide in the dormant season, that I know of, but it is also the best insecticide, and should be used in preference to all of the remedies, especially if there is a suspicion that the San Jose scale is, or may be, in the orchard. This may be supplemented by using the Bordeaux Mixture, (Formula III) as soon as the foliage is well out, and its use continued at intervals of about two weeks, going over the orchard from three to five times. Formula IV should be added to this for the codling-moth. These formulas readily combine, thus spraying for both the codling-moth and fungus diseases at the same time.

MILDEWS.

There are several mildews found on cultivated plants in Idaho. Among these may be mentioned Powdery Mildew of the grape, Gooseberry Mildew, Peach Mildew, Apple Mildew and Rose Mildew. Of these the most serious, and the only ones effecting much damage at present, are the first two. Like many other fungus diseases, these have two forms, a summer or conidial form, and a winter or perithecial form. The first occurs early in the growing season, the second later. The first appears in all of these mildews as a delicate, white, cobwebby coating on leaves, young stems, or even on the fruit. Sprays, to be efficacious, must be applied at this time. The second form coats the parts of the host with a dark covering, and when this has formed, spraying avails nothing, as the spray cannot reach the well protected spores. These spore bodies begin to form about July, so all spraying should be given prior to this month.

POWDERY MILDEW OF THE GRAPE.

This is found most abundant on the Vinifera or European type of grapes, being found hardly at all, in Idaho, on the American grapes.

TREATMENT.

In the spring use Formula No. I just as the leaves are coming out. In summer use Formula No. III. Better results will be attained by this method than by using the Bordeaux alone throughout the season.

BITTER ROT OF APPLES.

(The discussion below is based on "The Bitter Rot of Apples," published by the U. S. Department of Agriculture, Bureau of Plant Industry—Bulletin No. 44.)

Bitter rot is one of the most destructive of fungus diseases. It is found in twenty-seven of the eastern states, and is most prevalent in the central states. The loss occasioned by this disease alone amounts to $10,000,000 annually.

Up to the present time, bitter rot has not made its appearance in the Pacific states, and, if proper care be taken, it may never do so. It is included in this book partly to caution intending purchasers against buying trees already infested with the fungus, and partly to inform orchardists concerning its appearance and progress so that it may be recognized and coped with in case it does come among us.

The bitter rot puts in appearance at different dates during July and August, climatic conditions causing the varying of its seasons.

Warm sultry weather following a rain is a condition highly favorable to the development of the disease. It may be found in orchards in cool dry seasons, but it is then not so destructive. A few hot wet days in August may bring on a sudden attack which will prove very fatal in its results. Nights of heavy dew followed by hot days are likely to develop the disease. The whole crop has sometimes been destroyed, and that, too, in a few days.

The first sign of the bitter rot is in the form of a very faint light brown color under the skin of the apple. At first the spots are very small, and, as they grow larger, they become circular in outline. Their growth is very rapid, the color becoming a darker brown. When the spots are still no larger than one-eighth of an inch across, they seem to sink. The outline is sharply defined, and almost a perfect circle. When the diameter has reached one-half of an inch, little black spots appear at almost regular intervals beneath the skin of the sunken area. These increase in size, and project as tiny raised points. Afterward they break through the skin, and great numbers of spores thus escape. These spores, when not washed away, form a sticky mass which clings to the apple

when dry. On dry quiet nights the spores are discharged in long tendril-like threads which are the fruiting bodies of this disease. These black bodies are often formed in the shape of a ring. As the rot progresses, other rings of pistules appear outside of the first one, and at regular intervals, six, eight, or even more forming in rapid succession. Each ring has hundreds of pistules all producing spores at the same time so that numerous rings are appearing continually. The formation of these rings depends on the rapidity with which the fungus grows. The most perfect rings are formed when the growth is most rapid.

THE CANKER STAGE.

The cankers found in Illinois appear like blackened depressions on limbs of various sizes, sometimes on those of last year's fruit-spurs, and sometimes on limbs three or four inches thick. None of the cankers have yet been found on the main stock. The canker is a sooty black sunken spot, rounded or oblong in shape, and from one to several inches in length.

The fungus is likely to start at some small wound. It starts to grow in the bark and kills it and the cambium layer. The result

is that no new wood is formed at the point where the cambium is killed. As the fungus grows out from the place of infection, of course more and more bark and cambium are killed, so that by the end of the growing season, a very large spot on the limb is dead. It probably makes its first appearance in the bark in June.

Spray in the spring with Formula I; and in the summer with Formula III.

PHYLLOXERA VASTATRIX.

(Adapted from "Economic Entomology" by Jno. B. Smith, Sc. D.)

This insect winters on the roots of grapes, mostly as a young wingless form. It starts its growth in spring rapidly increasing in size and soon commences to lay eggs. The young, like their mother, remain wingless. They are also sexless and also lay eggs. So we may have a series of generations of similar creatures, no true sexes becoming developed, no wings appearing, and reproduction being entirely through unfertilized eggs. Some times in mid-summer some individuals acquire wings, and thus we get migrating forms, which issue from the ground while yet in the pupa stage; and as soon as they become winged, they fly and spread to other vineyards in the vicinity. Eggs are then

laid, usually three to eight being the range, while five are perhaps the usual number. They are of two sizes, of which the larger

Phylloxera vastatrix.—*a*, unaffected rootlet of grape; *b*, rootlets with newly-formed galls; *c*, same, with old and dried-up tissue; *dd*, groups of the lice on roots and rootlets; *e*, *f*, female pupa, from above and below; *g*, *h*, winged females; *i*, an antenna; *j*, oviparous wingless female and her eggs; *k*, root showing location of the eggs.

produces females, and the other, males. They come from the eggs fully developed and ready to reproduce. These curious creatures have become modified for the purpose of reproducing their kind. They cannot feed, for the mouth is aborted; nor fly, for they have no wings. After copulation a single egg, almost as large as the insect itself is developed in the female, and from it hatches a form which is like the type which started the cycle early in the season. Curiously enough, it occasionally happens that some of the wingless forms which remain under ground also lay eggs of two different sizes producing males and females, and thus it appears that winged forms are not really necessary to the continuation of the species.

Often wingless individuals abandon the roots and crawl up the stems to the leaves, where they form the galls, which are the most prominent external indications that a vine is infested. If one of these galls be cut open, the inside will be found lined with numerous minute yellow insects with dusky wings, which lie folded flat over the back; and in this particular the Phylloxera differs from the typical ophids, which have the wings vertical when at rest.

This insect has made its appearance in the

north of Idaho, but not as yet in the south. Experiments for its eradication have not yet proved successful. Horticulturalists are now at work on the problem.

CURL LEAF OF THE PEACH.

(Consult "The California Fruits" by Edward J. Wickson.)

The curl leaf is due to parasitic fungi. It occurs in various degrees. Mild cases do not seem to injure tree or fruit, severe cases destroy the fruit and sometimes the tree itself.

The disease is almost always at its height when the young fruit is about the size of small peas. If the curl is "bad," the fruit will fall to the ground, there not being healthy leaves enough to afford the required support. If, however, the curl is moderate and partial, only a part and sometimes none of the fruit will be lost. The disease, as is well known, is of brief duration, lasting, perhaps, from 12 to 20 days, after which the tree resumes a healthy appearance in every respect. If the fruit has been able to survive the ordeal, it appears to grow and become perfect as if no check had been felt.

Treatment: Spray in the spring with Formula I and in the summer with Formula III.

ROSE BEETLE.

The rose beetle is a red bug about the size of a small lady-bug, with long slender black legs and a proboscis about a quarter of an inch long. It appears on the rose bush before opening and bores a great many holes through the bud, causing it not to open. This beetle is very destructive to a rose bush. About the only remedy is to spray with poison.

HONEY SUCKLE BEETLE.

The honey suckle beetle is a lead colored bug, with long proboscis or bill. It eats in at the end of the young shoot and checks the growth. It also eats the foliage. It can be killed by a poisonous spray.

RED RUST ON BLACKBERRY VINES.

This is a fungus disease. About midsummer it will be noticed that the cane and the leaf of the blackberry turn red all over. Even the roots will be covered with red spots, some being one-fourth inch in diameter, and almost a solid mass over the leaf will be seen. The only remedy is to dig the vine up and burn it.

GRAPE SLUG.

(Larvae of Blennocampa.)

This is a black dotted worm about an inch

long, and it resembles a small caterpillar. It feeds on the leaf of the grape, causing the leaf to roll up. It is easily killed by using one ounce of white hellebore to one gallon of water.

FROZEN SAP BLIGHT.

Frozen sap blight is caused by the excessive dryness of the ground early in the season.

The sap rises and the tree makes a short growth. Not having nourishment, the tree concludes its growth early in the fall. When the fall rains commence, if the weather continues warm, the tree starts to make another growth. Before the sap has time to come back down the tree to make the cell-growth that enlarges the stem of the tree, freezing weather comes, and the sap is frozen in these cells. It becomes dark and discolored, and sticky; and remains there failing to go down to the roots. The next year the new sap rises, the tree leaves out, and the fruit and growth starts just as if nothing were wrong, but by July when the sap gets back down the trunk where it was frozen in those cells it is not able to pass this frozen sap, and consequently the new sap oozes out, and runs down on the outside of the bark. When examined, the sap smells soured, or like anything that has been frozen and thawed. The tree will

then begin to die. For this disease there is on remedy. The only preventative is the proper watering of the tree.

THE BOX ELDER BUG.

(Dysdereus Sutrellis.)

This is the red bug or cotton stainer. It has a long beak and a head of moderate size. The body is rather hard, and the color is a brilliant black and red. The insects feed on the leaf of the box elder and are quite troublesome about the house. They are found in all crevices on the outside of the houses if box elders are near. They are quite a pest in the southern states, as they work on cotton seed, and stain the cotton red; they also attack oranges in Florida. They are trapped by placing small heaps of cotton seed in a grove to attract them where they can easily be destroyed with pure kerosene.

The young are found on the box elders in July.

FALL WEB WORM.

(Hyphantria Cunea.)

This species appears at its worst in the fall (hence its name,) while the apple tree tent caterpillar appears only in the spring. There are several species of tent caterpillar in Idaho. Among the number are the forest tree caterpillar, the yellow-necked caterpillar, etc.

All of them are on the increase and should be destroyed as soon as discovered. This can be done either in the egg state, by destroying the eggs wherever found the eggs are easily seen appearing in masses, stuck fast to the branches of the trees, etc., or in their tents, when they appear later in the season,) or by cutting off the branch and burning it, or by taking a piece of old cloth, saturating it with coal oil, fastening it to the end of a pole, setting it on fire and burning by passing the flame quickly around the limb under them. Use Remedy No. III, if there are too many of them for the above treatment.

THE FOREST TREE TENT CATERPILLAR
(Malacosoma Fragilis.)

(The following press bulletin by Prof. J. M. Aldrich, of the University of Idaho, Agricultural Experiment Station, is inserted by permission.)

The insect was very abundant and destructive in the vicinity of Bellevue last season, and will be much more so this year. Hence it seems necessary to call the attention of residents of that neighborhood and the surrounding country to the necessity of early and thorough treatment for the purpose of reducing the injury as much as possible.

The mature insect is a moth of medium size and yellowish color. The damage is

done by the larva or caterpillar, which when full grown is a long blackish kind, with a few small lighter marks and a narrow bluish stripe down the middle of the back. It is somewhat hairy, and the skin has a covering of black, velvety down.

The life history is as follows: The eggs hatch early in the spring, as soon as the leaves of trees begin to unfold. The eggs being in masses of a hundred or more, the insects appear in colonies, and begin to spin a web on branches about or near the place of hatching. They soon devour all the foliage near this web, and before half grown they scatter and do not afterward live in the web or in a colony. They reach their full size about July 10, and make a yellow cocoon on the tree, enclosed in a few loose threads of silk. They usually draw together a few leaves, or fragments of leaves, to form a partial cover for the cocoon. It may be formed at some distance fifty feet or more from where the caterpillar has been eating. The next stage is passed in the cocoon; it is brief, and the moths come out about July 20. They proceed at once to lay eggs for the next season. These are placed on twigs or branches, in the form of a brownish mass, covered with a frothy material so that the

shape of the eggs cannot be distinctly seen. There are about a hundred eggs in a mass, and they are laid before the first of August. Nothing further happens until the next spring, as there is only one brood of the insect in a year.

Their favorite food is the balm of Gilead or cottonwood, many trees of which were almost entirely stripped of leaves last year along Wood River, in a region extending from two miles above Bellevue to three miles below. There will naturally be considerable spread this year, and trouble may be expected for several miles beyond this area.

Last year several other kinds of trees and shrubs were also eaten, and there is danger that the species will be so numerous this year as to cause serious loss to shade and ornamental trees, currants, gooseberries, and other small fruits, and to fruit trees where they occur.

REMEDIES.

The first thing to do is to examine one's own premises immediately on receipt of this warning, to see if any eggs have been deposited. The egg-masses are easily recognized, as no other insect in the vicinity makes the same kind. If found, they should be destroyed. Crushing the mass or cutting

off the twig and burning it is perfectly effective and very easy. On large cottonwood trees little can be done; but no doubt the eggs are numerous on small trees and shrubs in many places at some distance from such trees. Here the attack can be nipped in the bud. This preliminary work is very important.

After hatching, the caterpillars may be destroyed by spraying their food plant with Paris Green, one pound to 150 gallons of water. This will apply especially to garden fruits, etc.

In the immediate vicinity of Bellevue, early and constant attention will be necessary. At more remote places, at least the first inspection should be made; unless the eggs are found on the premises or near by, there is but little danger of trouble this year. The amount of spread which occurred last year after the moths hatched and before they laid their eggs is not definitely known; it may have been several miles.

The caterpillar suffered considerably last year from the attacks of several parasitic insects. There is reason to expect that these parasites will increase, in a year or two, enough to reduce the number of caterpillars; but the immense number of eggs that were

laid last year makes it certain that the trouble will be worse this year than last.

The worms do not travel as a rule more than a few hundred feet from the place of hatching; but the moths may fly a long distance before laying eggs. Hence the spread occurs after the insect has finished feeding for the year.

The experiment Station will correspond with any who desire further advice.

FIRE BLIGHT.

(Sometimes called "Pear Blight.")

(A press bulletin issued, dated March, 1904, by Professor L. F. Henderson, of the Idaho Experiment Station, which covers the ground very fully, is herewith appended.)

The name "Fire Blight" is the proper one to use; it should not be called "Pear Blight" for two reasons. In the first place it is liable to be confused with the Pear-leaf Blight, a disease which attacks the leaf of the pear, and incidentally injures the fruit. In the next place this disease is not limited to the pear; it is fast becoming too common on the apple as well, in our state. Nay, in many states it attacks all of the pomaceous fruits, such as pear, apple, quince, crab and hawthorn. Three years ago, this disease was unknown to the writer in the southern part of the state; to-day, there is hardly an

orchard in certain districts which does not show some blight, and in many it is very serious. In Northern Idaho it has been in our pear orchards for over ten years, but luckily it has hardly ever attacked the apple. From the devastation this disease is causing in the Southern Idaho apple orchards, we cannot expect that the northern portions of the state will long be exempt.

HISTORICAL.

Though this trouble has been known as working havoc in the orchards for a century or more, it is only in comparatively recent times that its true nature has been well understood. For a long period of years the discussions of this trouble were of such a theoretic nature, that many horticultural societies forbade its being brought up in their meetings, unless someone had something of absolute knowledge to offer about it. Various causes were ascribed for its presence, such as "sour sap," "atmospheric conditions," "soil conditions," and "effects of various fungi." In 1878, however, Professor Burrill of Illinois discovered the true cause and announced his discovery to the world. This was found to be a bacterial disease, due to the presence of myriads of little germs in

the inner bark and cambium. The germ was called by Prof. Burrill Micrococcus amylovorus from the eagerness with which it seizes upon and devours the starch in these tissues. From the subsequent studies of Arthur at the Geneva Station in New York, and of Waite in the U. S. Department of Agriculture, we know how this germ or bacterium lives, reproduces itself and is carried from tree to tree.

APPEARANCE OF BLIGHT.

Luckily the disease is a very conspicuous one, which renders its presence in an orchard the more inexcusable when well known. It effects twigs, leaves, young fruit, and even the branches or trunks. From the experiments of Waite, it has been found that it cannot attack the plant through the uninjured bark or leaf. It can, however, gain entrance through any injured place on trunk, limb or even leaf. Its most common points of entrance are natural ones. These are the young growing tips of the branch, the stigma of the flower, or the glands which secrete nectar. Therefore the "flower-blight," the "twig-blight," and the "branch or trunk blight" are all forms of this disease.

In the first, the young twig, especially if

it be growing rapidly, turns black in both leaf and stem, and wherever the leaves are blighted, they remain black and dead through the ensuing winter. This black, piratical flag is the surest evidence of its presence.

In the "flower-blight" a whole bunch of flowers, or frequently every bunch upon the tree will be affected, and dying back to the beginning of the spur, hold the blackened flowers and young fruit also through the entire year. This is the most common form on the apple.

Frequently an entire limb or even the trunk will be affected for only a short distance, while the top will still be entirely free from the disease, and this can only be understood when we speak of how the disease is spread.

More frequently upon the pear several limbs and even the whole trunk will be affected, and when this is the case the tree should be cut out root and branch.

MEANS OF DISSEMINATION.

If the young shoots of a tree affected with blight be examined, small drops of sticky, thick fluid will be found exuding from the edge of the diseased area. If one of these drops be examined with a high power

of a microscope, myriads of little oblong bodies will be seen, some separate, some in short chains. These are bacteria. Arthur proved that these bodies, innoculated into a sound tree by a needle, would produce the disease; Waite proved to us beyond dispute that insects, especially bees, are the main instruments in their dissemination. They are attracted by the viscid sap, suck up part or all the drop, and then carry thousands of these germs with them to innoculate flowers, shoots, or wounded places in the bark. Undoubtedly heavy currents of wind assist in spreading the disease and probably account for the commonness of "twig-blight." The question comes right here: Shall I keep bees if I have an orchard? Certainly, and for two reasons. First, the honey, and the revenue derived from it, are often no small object to the farmer. Second, the bees are absolutely needed to assist in proper cross-fertilization or pollination of the flowers. This leads us to the subject of remedies, for preventatives there are none.

REMEDIES.

As soon as the bacteria are carried to young flower or wound, they affect entrance, and living upon the sap and starch, multiply

rapidly. If they gain entrance along a limb or trunk, they live in the inner bark and cambium-layer,—that layer which adds yearly to the growth of both bark and wood.

It can readily be seen from this that they are well covered, and consequently spraying does no good. The only remedy thus far found has been and is the careful and continuous use of the saw and pruning knife. All diseased shoots and limbs should be cut off at from 6 inches to one foot below the place of evident infection or injury, as the bacteria have always gone down deeper into the limb than seems to be the case from the outside. Many pruners have the habit of splitting down the bark to see how far the disease has proceeded, but this practice is to be condemned, as they never can see how far the disease has proceeded, and the incision of the knife may carry the bacteria from diseased to healthy tissues. If the blight is bad in either the pear or apple-orchard, the knife or saw should be sterilized each time it is used, by either passing it through a flame or dipping it into weak carbolic acid-water, or into kerosene. The pruned limbs or fragments should be collected and burned and both pruning and burning should be done mainly in the dormant season, before the sap

has started, the bacteria have awakened, and the bees are visiting the orchard. This is the best time for pruning and burning, but not the only one; it should be done whenever the disease makes its appearance. All large wounds should be painted over with paint as soon as the tree is trimmed, to prevent the re-innoculation through the exposed tissues. Where the blight is bad, even young shoots or water sprouts should have their cut bases painted, for it has been shown time and again that the limbs and even trunks have been innoculated through these cut stubs.

The pear is much more easily pruned for this disease than is the apple. On the former it commonly manifests itself in dead or dying shoots, limbs, or trunks, which can readily be cut away below the progress of the disease. On the apple, however, it is commonly the shoots all over the tree, and especially the fruit spurs and their clusters of flowers, which are most affected. Pruning here becomes a much more difficult and even serious undertaking. Where only a few shoots and fruit spurs are affected these can be cut away close to the tree, and the wound immediately covered with paint. Where, however, almost all of the fruit spurs on the whole tree have died, the best way is to cut

off entire and large limbs, cover the wounds with paint, and stimulate the production of new shoots and subsequent fruit spurs. Many such trees are to be found in and around Boise, New Plymouth and many other places. In the former place my attention was called by Inspector McPherson to a very interesting though sad evidence of the efficacy of bees in spreading the disease. All the splendid large apple trees near the hives were without exception seriously injured by blight, while as we proceeded on radii from the hives the blight grew less and less, and almost disappeared on the edge of the orchard farthest from the hive.

(The orchard here referred to is now practically free from blight, which goes to show that the blight can be controlled by following the approved methods.)

OTHER HELPS.

It has been often noticed that rapidly growing trees are more subject to blight than slower growers, and that those in low ground or "swales" are more subject than those on drier ground. Orchards should therefore be planted on well drained land, and should not be stimulated by too much water or too much fertilizer.

Though all of the varieties of the pomaceous fruits are subject to this disease, as

said before, some varieties have been found more subject to the attacks of blight than others. Of the apples, the crabs of all kinds have been found very prone to blight. Amonst the pear, in most places, the Anjou, Angouleme and Seckel are most resistant, Bartlett and Flemish Beauty are less so, while the Idaho, Clapp and Winter Nellis are very subject to blight.

L. F. HENDERSON, Botanist.

THE APHIS, OR PLANT LOUSE.

For the following description of the Aphis I am indebted to Smith's Economic Entomology.

The plant lice are well known to agriculturists by the injury they cause, and they are interesting to the naturalist from their life history. Here we have the most striking apparent exception to the general rules that insects are developed from eggs, and yet perhaps the exception is more apparant than real. At all events parthenogenesis, or reproduction without the intervention of a male occurs normally in a large percentage of the species. Of course they are many differences in life habits, but a general account, covering most of the cases, is all that can be attempted here. As a rule, plant lice winter in the egg stage; but this is subject to many exceptions, especially in the warmer parts of the country.

Early in the spring, as soon as there is a trace of reviving vegetation, these eggs hatch. The insect that now appears is wingless, and usually remains so, but grows rapidly by sucking the plant juices, and soon begins to produce living young. It is called a "stem-mother," because it is the source from which numerous generations issue during the season. All the young born by this stem mother are, like herself, without sex; that is they are neither males, nor sexually developed females. The rate at which they are born, varies, but as many as eight living young have been observed within a period of twenty-four hours from one specimen, and it is not unusual to find, early in the season, a single large louse surrounded by a group of anywhere from a dozen to twenty or even more small specimens. The rate of growth also varies, depending upon the weather; indeed weather conditions, early in the season, frequently determine the question of whether or not certain species are to become injurious later on. A warm moist temperature favors their development, and reproduction goes on at a rapid rate. Correspondingly, cold, wet weather checks development, and may even destroy a large number, particularly the young. Plant lice, in their young stages, are exceedingly

susceptible to sudden changes of temperature, and at almost any time in the season a sudden drop of from fifteen to twenty degrees, accompanied by a rain, will prove fatal to a great proportion of them. But assuming that all is favorable, the young that were first brought forth, are in turn ready to reproduce in five or six days, and they also form little colonies; this method of reproduction continuing as long as food is plentiful and weather mild. Experimentally, reproduction of this kind has been continued for several years in succession, without any tendancy to develop sexed individuals or to produce eggs. At almost any time after the first generation, specimens may become winged, and these fly to other localities, forming new colonies wherever suitable food is found. In this way they spread, and, though they may have started from a single favorable colony, they yet in their course of a few weeks, cover many hundreds of acres. Exactly what determines the formation of wings in some specimens and not in others is not known. We do know, however, that the progeny of a single individual is variable, and that some become winged, others do not; but whether winged or wingless, the specimens are equally without sex, all are viviparous, or bring forth

living young. As the summer advances reproduction becomes less rapid. Plants tend to dry, the supply of sap is not so plentiful, and these features become more marked through the autumn months until, with the approach of cold weather, plant growth entirely ceases. It becomes necessary now to provide for the continuation of the species during winter, and sexed forms are developed. The males are usually winged and appear a short time before the females, which differ by the lack of wings and the usually small size compared with the normal sexless form. Pairing takes place as soon as the female is sexually matured, and in a very few days afterwards eggs are laid. In many instances the egg supply is exceedingly small, indeed, they may be one only matured by a female. Even this many remain within the body of the parent, who simply dries up the skin shrivelling around and forming a protection to the ovum. More usually several eggs are produced, and these of large size in proportion to the insect that lays them. They are green or greenish-brown in color when laid, sometimes yellowish and frequently darken to black. They are placed in sheltered situations on plants, and, in the case of orchard trees, are usually found at the tip of the twigs, around

the buds, or on the leaf-scales where vegetation will first start, in the spring following. They are very firm in texture and very resistant to insecticides; in fact, it is impossible to destroy them except by the most caustic mixtures. It has been already indicated that there are many exceptions to this general life history, and one exception we find where species feed during the summer upon a plant which dies down to the ground, leaving nothing through the winter. In such cases there is an alternate food-plant, upon which the winter and early spring is passed. From this the insects migrate in early summer and to it they return when cold weather sets in. Such a case we have is the hop louse, which spends the summer upon the hop increasing greatly in number in favorable seasons and often causing much injury. When the vines mature and die, males develop, and all the lice fly to plum trees. Here the female is born, the sexes mate, and eggs are laid. In the spring two or more generations mature upon the plum, and, when the vines are again well started, winged forms develop and migrate to their summer food plant. This sort of migration is not unusual, although it has not been traced out in many cases.

Another example we find in the "melon

louse," which has a considerable range of food plants, including cotton, orange, strawberry, and nearly all the common weeds of our fields. If circumstances favor their increase in spring, winged forms are produced which migrate and settle upon melon fields, providing for colonies during the summer.

The scientific problems connected with this method of reproduction and spread are of great interest, but cannot be entered upon here; the mere statement of the case being sufficient for practical purposes. Plant lice are so commonly known that a detailed description of their appearance is unnecessary; but it is well to call attention to the presence of a pair of little tubes or cornicles near the end of the abdomen, projecting from the upper surface. These are called honey tubes, and from them is excreted a sweetish liquid known as honey-dew. Sometimes, when food is abundant and the insects are active, the amount of sap they pump out of the plants is so great that, in order to ease themselves, they void it in little streams through the anus, as well as in drops through the honey-tubes. Thus the leaves of infested plants become sticky or glazed with a sweetish liquid, on which a black fungus rapidly develops, the leaf being frequently killed by

simply choking to death. Sometimes the vegetation beneath a tree becomes thoroughly coated in the same way, or, when shade trees in cities are infested, the pavement becomes wet and slippery with the viscid liquid. This honey-dew is often attractive for their distribution. As they never come to the surface, so far as we know they are never winged, and are usually dull white in color, or, with a slight tinge of green. The body is covered with a whitish powder and lacks honey-tubes.

WOOLLY APHIS.

In my district I have gathered thirty-two different kinds of Aphis, which differ in size, form and color. Some travel rapidly over the foliage while others are very slow in their movements, each apparently having its particular tree or plant to feed on. Of all the Aphis, I consider the woolly aphis the most destructive, as it works on the stems and roots of all seeded fruits causing the root to knot or gall, as shown in Fig. *a*. This checks the growth of the tree. Be careful in buying young trees not to get infected trees. When working on the stem they cause the place where they are working to become enlarged. This is generally where a limb has been cut, or where there is a bruised place on

Figure 14.

the tree. These cover themselves with a secretion resembling fine cotton fiber which conceal them more or less completely. Some become winged as shown in Fig. *d* page 130.

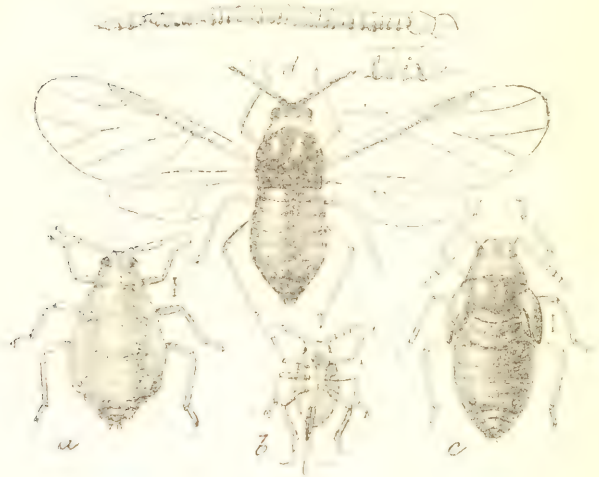

Figure 15.

PURPLE APHIS.

The Purple Aphis comes next in my opinion to the woolly aphis, as where they are bad the apple tree's fruit will not mature, but wither up and hang all winter on the tree. The other thirty varieties feed on trees and plants, and the following is the list of trees and plants upon which they feed:

The Prune Aphis,	Rosebush Aphis,
Wild Plum Aphis,	Currant Aphis,
Peach Aphis,	Honeysuckle Aphis,
Cherry Aphis,	Holly Hock Aphis,
American Elm Aphis,	Golden Rod Aphis,

Box Elder Aphis,	Old Man Aphis,
Philbert Aphis,	Sour-Dock Aphis,
Cotton Wood Aphis,	Hop Vine Aphis,
Black Locust Aphis,	Cabbage Aphis,
Soft Maple Aphis,	Willow Aphis,
Catalpa Aphis,	Black Walnut Aphis.

The balance feed on plants, and the only thing that holds them in check is their natural enemy—the Lady-bug, Syrphus flies, Lace wing flies and Parasitic flies.

TREATMENT OF APHIS.

Where woolly aphis is working on the root of a tree you dissolve ½ lb. of Lye in 4 gallons of water, dig the dirt away from the root next to the stem, and pour the solution around the roots of the tree, by wrapping a stalk of long green tobacco around the stem of the tree in the spring, the Aphis will not come up. To eradicate the Aphis working on the foliage, use formula number two.

Wherever Aphis are found working on a tree you will see an abundance of ants, as they feed on the honey-due and fight the natural enemies of the Aphis away. Ants can be eradicated by punching holes in the mound and nest and inserting about a table-spoon of bi-sulphide of carbon in each hole. Fill the hole with earth. Caution must be used with this remedy as it is explosive.

THE COCCINELLIDAE.

(Natural enemies of the aphis, for whose description I am again indebted to Smith's Economic Entomology.)

The next family meriting attention from its economic interest is the Coccinellidae, or, as the species are commonly called, "lady bugs" or "lady birds." Scientifically these insects are distinguished by having the tarsi three-jointed only; but practically they are recognized by their oval or round form—always convex, sometimes almost hemispherical, and by their colors, which are either of some shade of red with black spots and markings, or black with red or yellow spots. The species are never large, sometimes very small; but in almost all cases are predaceous, their prey consisting of chiefly plant lice or scale insects.

The larva, which have the same feeding habits, are usually fusiform, with a small head and quite long legs. They are often prettily colored, sometimes with spiny warts or processes, and may be seen running about wherever plant lice abound. Patches of fifteen to forty of the yellow eggs laid by the beetles are often seen in abundance on infected plants.

The species of Megilla and Hippodamia are more oval and less convex than

usual, and some of them have been found feeding on pollen or even seeds when their natural prey was scarce; yet I have observed these same species doing yeoman's work in the destruction of plant lice on melon vines.

The general Adalia and Coccinella contain the more hemispherical types, and among the most common are the "9-spotted lady bird," Coccinella 9-notata, which is one of the largest species, and the "2-spotted lady bird," Adalia Bipuncta, which is the smaller, and perhaps more frequently seen in the gardens and even homes. Among the largest of our forms is the "15-spotted lady bird," Anatis 15-punctata, interesting from its color variations, ranging from creamy white with black distinct spots to uniform mahogany brown.

Opening quite a distinct series of species, which are black with red or yellow spots, is the "twice stabbed lady bird," Chilocorus bivulnerus, in which the larvae is spiny. This is black, almost hemispherical, with a somewhat ovate red spot on each wing cover, and is found throughout the United States. Its chief food, in the larvae as well as the adult stage, consists of scale insects, and it is one of the most effective checks of that kind

of plant pest, under favorable circumstances ridding individual trees completely.

We have other similar but smaller species, sometimes with numerous yellow spots on the wing covers, and most of them have the scale eating habit to a greater or less extent. The species of Pentila are uniformly black and very small, less in size than most of the scale insects upon which they prey; but they, as well as their minute spiny larvae, are great feeders, especially upon the eggs and larvae. The destructive San Jose scale has no more persistent, effective enemy than this kind of lady bird.

The species of Scymnus are also small, usually recognizable by their fine pubescent or hairy clothing and black colors. There is a tendency to redtipped wings, covers or red thorax, and these forms also prey largely upon scales. To this family belong the Australian species of Vedalia, Orcus, and Rhizobius, introduced to destroy the also imported "cottony cushion scale," Icerya purchasi. The relation of these species has already been discussed when speaking of the scale.

There are few rules without exceptions, and so we find sinners among the "lady birds" also—all belonging to the genus Epilachne. The species are large, hemi-

spherical, and yellow with black spots. The larvae are also yellow, elongate oval, with long branched spine. E. borealis is the Northern and Eastern species attacking cucumber, melon, and similar vines, while E. corrupta is found in the West and Southwest, injuring beans. A curious feature in E. borealis is the manner in which the adult marks out a circle at the edge of a leaf and feeds within it until all usable tissue is exhausted, before proceeding to another place to repeat the operation.

As these injurious species feed openly in all stages, they can be reached without trouble by any of the arsenites.

SYRPHIDS.

Syrphids is often composed of spurred and branched hair similar to that found in bees, and in the "dronefly" this character is especially marked.

As widely divergent as the flies themselves are larvae and their feeding habits. In fact, there is no sort of agreement; and while some are predaceous, feeding upon plant lice or other insects, many feed on living or decaying vegetable substances, or in the foulest excrementitious material. Those forms that most concern the agriculturist are the feeders on plant lice, and these may be found at

almost any time during the summer in almost every aphid colony, busily engaged in lessening its numbers. The larvae are easily overlooked, as they are usually green or yellowish in color, like the insect among which they feed. They are wrinkled and hairy when examined with a magnifying glass, soft in texture, thickened behind, and tapering almost to a point at the head which is marked only by a pair of hooks and a little circular opening representing the mouth. They have no legs and move by extending the body forward as far as possible, then clinging with the anterior segments to the leaf or twig, and drawing the balance to meet the head. Awkwardly as they move, however, their progress is yet sufficiently rapid for their purpose. When once a larvae has established itself in a colony of plant lice, it never stirs until all in its immediate vicinity are destroyed; it then moves only far enough to bring into reach additional prey, and so continues until no more remain.

The female lays her eggs close to, or actually among, an aphid colony, so that the larvae finds food ready at hand as soon as it is hatched. It grasps a plant louse with the mouth's part, lifts it from the surface, and sucks its juices, leaving the creature to strug-

gle for awhile, helplessly kicking its legs in mid air. When the juices are exhausted the empty shell is dropped and another specimen is taken. When full grown, the larvae draws itself up into a humped mass; the outer skins harden, darkens in color, and forms an apparently solid covering or coarctate pupa, beneath which the true or soft pupa of the fly is formed. Several broods of these predaceous flies occur in the course of the season, and they are among the most important checks that nature has provided against plant-lice increase.

THE HEMEROBIIDAE.

The Hemerobiidae, which contains numerous specimens of interest, are all of them predaceous and beneficial to the farmer. There are several sub-families, which together are termed "lace winged flies," from their delicate, finely reticulated or netted wings, which lie flat and are not folded. The insects are slight, and in the species allied to Hemerobius the colors are brownish or smokey. They are less common than the forms allied to Chrysopa, which are green, with long antennae and prominent, bright, yellowish-brown eyes, which have given them the name "golden eyed flies" in some localities. They are commonly found in

fields or along the edges of woods, and emit, when handled, a peculiar sickening odor which is quite unmistakable when once known. In the adult stage the insects feed little or not at all; but the larvae, known as "aphis lions," feed almost constantly, their prey being small, soft bodied insects of all kinds, aphids or plant lice ranking as special favorites.

The entire life history of the insect is interesting. The female in oviposing touches the end of the abdomen to the surface—usually a leaf—upon which the eggs are to be laid, and then elevates her body about a quarter of an inch, emitting at the same time a viscid thread which hardens on exposure to the air. At the tip of this the egg is fastened, and we thus get a little grove of eggs on stilts. This is supposed to insure their safety from wandering predaceous forms that might otherwise feed upon them. When the larvae hatches it climbs down the slender thread, and attacks and feeds upon the first suitable specimen it can find — usually a young plant louse. Now, here is another peculiarity, it does not chew or tear its prey, but holds it firmly, sucking the juices by means of grooves on the inner side of the large mandibles which are closed by the

slender maxillae. The larvae grows rapidly, becoming rather more than a quarter of an inch in length, narrow, spindle shaped, pointed at the anal extremity, the head distinct with prominent sickle shaped mandibles. When full grown, it spins by means of anal glands, a perfectly spherical, white, silken cocoon of very dense texture, and small in proportion to the larvae. It resembles a moderate size pearl in form and appearance, and when the adult is ready to emerge, a circular lid is lifted off to give the matured pupa exit. Comparing the fully developed insect with the cocoon from which it issued, the marvel is great that it was ever packed away in so small a space.

These insects are really of much practical value, frequenting, as many of them do, tilled fields and orchards, feeding upon larvae, plant lice, and similar creatures. They become injurious, however, in some parts of California, where they attack and destroy coccinellid or lady bird larvae.

Somewhat closely allied in all stages to the Hemerobiidae are the Myrmeleonidae, or "ant-lions," but they are larger, with longer and narrower wings, and clubbed antennae. As before, the adults are graceful, harmless creatures, which fly mostly at night, while

the larvae are predatory, resembling the "aphis lions," in structure, save that they are broader and chunkier in appearance. They are also peculiar in that many of them capture their pray in pits or traps.

In constructing its trap, the larvae usually selects a spot of moderately compact fine sand, and excavates a funnel shaped pit with sides as steep as the sand will lie. It remains buried and invisible in a little gallery at one side of the bottom, in wait for any unlucky creature that may come within reach. Ants are the most frequent victims from their wandering habits and a tendency to investigate, a pause at the brink resulting in a slip of sand and a tumble into the jaws of the enemy. Should the ant recover a footing before reaching the bottom, a shower of sand, sent by the vigilent larvae below, overwhelms and brings it down to its death. When the juices are exhausted, the empty shell is thrown out of the pit and it is repaired for other victims. Sometimes pits are made in sawdust or friable leaf mould and some make no pits at all.

The adults are of two rather distinct series; the first with short antennae which thicken rather gradually toward the tip, including Myrmeleo; the second, with long, slender

antennae, enlarging suddenly into a flattened club. The head is larger and the body more robust, covered with stiff, bristley hair, giving the insect a fierce appearance. The most common genus is Ascalaphus, and the larvae habits are not known, though it is probable, from what we learn of foreign species, that they do not build pits or traps. Though interesting the family is of no economic importance.

STRAWBERRY ROOT-BORER.

(Wickson's California Fruit.)

The larvae of another clear winged moth (Aegeria impropria), boring into the root of strawberry plants, found in various portions of the State, and doing considerable damage, forcing the growers to resort to replanting much earlier than would otherwise be necessary. Flooding the vines has a great tendency to kill out the worms, and if the water was retained, say four or five days during the winter, all over the plants, doubtless all of the larvae would be killed.

CURRANT AND GOOSEBERRY BORER.

A white worm eating out the central pith of currant and gooseberry plants—the larvae of another clear winged moth (Aegeria tipuliformis). Spraying with whale oil soap

after the crop is gathered, pruning out and burning in the fall of all old wood which can be spared, will reduce the evil.

THE AGRILUS.

Smith's Economic Entomology.)

The genus Agrilus contains species differing from any of those heretofore mentioned by their slender, cylindrical form, the head

Figure 16.

squarely truncate, or cut off in front, the elytra much narrowed at tip. As a rule, these species are dull brownish bronze in color, the prothorax sometimes brassy or red-bronzed, and none is better known than the "red-necked blackberry borer," Agrilus ruficollis, the author of the "gouty gall" on that plan. The larva in this genus are usually long and flattened, the segments strongly marked, the "head" not much wider than the body, and the anal forks distinct, differing in each species.

Returning to the blackberry borer, it is good practice to cut out all galled canes early

in spring and burn them. Trimming is done at this time as a matter of regular cultivation, and the galls are then easily seen. No "galled" cane can ever ripen a fair set of berries, and it might as well be cut out at once. Another satisfactory method is to cut off all the new shoots at the surface of the ground about the end of June. At this time all of the beetles have laid their eggs, and the shoots which come up in July cannot become infested. The best results will be obtained by combining both methods. Cutting the new shoots causes the death of the young larvae, which are unable to subsist on dead wood, and being footless are unable to migrate to new stalks.

ANTHONOMUS SIGNATUS.

The A. signatus, or the "strawberry weevil," which appears as a small, blackish beetle, with gray pubescence, when the buds are developing, and lays and egg in each, afterward puncturing the flower stalk below the bud so as to check development. The larva feeds upon the pollen in the unopened bud, and finds it sufficient to attain its full growth, changing to a beetle in midsummer. The insect attacks a number of other flowers in the same way, not even confining itself to

one natural family, and its injury to strawberries is of a somewhat intermittent character, becoming worse for a number of years, then stopping suddenly for no apparent reason. Only staminate, or pollen bearing varieties are attacked, and the Sharpless is, perhaps, the most seriously infested. By planting chiefly pistillate varieties, the staminate rows may be protected by cheap coverings until the buds are ready to open, and even if a small crop only is obtained on the pollenizers, the main crop will be safe without protection. Insecticides have not proved markedly useful in this case.